

Race Management Guidelines 2018

Introduction

These guidelines come from many sources including the Olympic regattas of Sydney, Athens, Qingdao, London and Rio, the Sailing World Championships of Perth and Santander, individual class championships both here in New Zealand and overseas and John's membership of World Sailing's Race Management Sub-Committee since 2008. They are heavily influenced by New Zealand club and national events in both dinghies and keelboats.

We would like to acknowledge the influence of World Sailing and the international race officers we have worked with including Paul Ulibarri (Canada), Nino Shmulei (Israel), Charley Cook (USA) and more recently Tom Duggan (USA). Our New Zealand race officers and their assistants keep us grounded in the practicalities of the diverse range of events that are run in New Zealand.

We also acknowledge the contributions of Jim Park, Richard Brown, Ian Clouston, Kim Admore and the Yachting New Zealand Race Management Sub-committees since 1997. The support and contributions of the staff at Yachting New Zealand continues to be significant.

New in 2016 was more data to enable race management teams to manage meeting target times. The basis of this is information from the RYA, in particular, work done by David Campbell-James (England). New in 2017 is our current thinking on the safety plan and a dedicated Safety Officer whose role is to oversee the safety team.

We embrace the principles developed in these guidelines and apply them to all regattas we are involved in both in New Zealand and overseas. We know we have been fortunate with the number, quality and enthusiasm of the race management teams we have worked with and we acknowledge them for their contribution to our sport.

We hope these guidelines help ensure quality, predicable, consistent and fair race management. Sailors can then concentrate on how they can make a difference to their place in a race or series by the way they sail.

A document of this type is a conglomeration of ideas that have come from many sources and has evolved over many years. We expect it to continue to evolve and encourage debate and ongoing improvement.

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Useful Publications

Title	Available from
Racing Rules of Sailing YNZ Safety Regulations	Available for purchase from YNZ online shop http://www.yachtingnz.org.nz/shop , or contact YNZ
YNZ Club Safety	YNZ
YNZ Event Packs	YNZ
YNZ Log book for Race Officers	YNZ
Race Committee Assistant Log Book	YNZ
Race Committee Mark Layer Log Book	YNZ
World Sailing Race Management Manual	http://www.sailing.org/raceofficials/internationalraceofficer/document_library.php
World Sailing Standard Notice of Race	
World Sailing Standard Sailing Instructions	
Race Management Policies for World Sailing Events (Fleet Racing)	
Race Management Policies for World Sailing Events (Teams Racing)	
Race Management Policies for World Sailing Events (Match Racing)	
World Sailing Case Book	http://www.sailing.org/documents/caseandcall/case-book.php
World Sailing Racing rules Q and A	http://www.sailing.org/raceofficials/qandaservice/doc_list.php

Useful YNZ web pages

YNZ Regatta Documents: <ul style="list-style-type: none"> • YNZ Standard entry form, NOR & SI's • Regatta Organizer Checklist • Risk Management Guide • YNZ Regulation 4.5.4 (Major/ National Events) • National Event Applications & Report forms 	http://www.yachtingnz.org.nz/events/event-management/event-resources
Qualified Race Official Database & Search (includes Race Officers, Judges & Umpires)	http://www.yachtingnz.org.nz/coaches-officials
Education & Training opportunities for Race Officials	http://www.yachtingnz.org.nz/coaches-officials/seminars-training
CRO and NRO application forms	http://www.yachtingnz.org.nz/coaches-officials/officials-information/race-officers
Race Officers Regatta report form	http://www.yachtingnz.org.nz/coaches-officials/officials-information/race-officers/regatta-report-form

Useful Weather Sites

www.metservice.co.nz

Inshore, then recreational marine forecasts.

www.metvuw.com

The rain radar is good to see the speed of approaching rain. Victoria University Weather. Forecast charts – give 6 hourly charts for next ten days – good to see if it is going to rain!

Smartphone Applications

Coastguard - good for nowcasting and weather forecasts.

Navionics – for ipad(needs to be cellular capable) and iphones (also available on android)

Tides NZ – Pictorial display of tides showing current tide height, next high and low

Metservice – quickest way to get to the rain radar image

Predict Wind

Wind Guru

Windy

Memory Map

Inclusion on the Race Course

Good race management is good race management regardless of who is on the water. Sailing theory, rules, and tactics are the same for everyone, although physical parameters may be different when working with sailors that have a disability.

Ask disabled people how their impairments may affect their sailing rather than make an assumption. Try to talk to the participants one on one at registration or after the briefing- they may not want to raise certain issues in a group discussion.

Managing a disability is very much the responsibility of the individual concerned. However, race officials and regatta managers should be aware that:

- The briefing needs to be in an accessible location that everybody can get to.
- The bigger and brighter that marks are... the better for everybody, especially people with vision impairment.
- Some sailors may not be able to physically fix their boat, particularly people using an electronic servo as batteries may die or winches override. Keep an eye on, and in radio contact with support boats.
- Sailors may often carry VHF radios subject to restrictions in the class rules. These should be cleared with the Race Officer before racing begins.
- As a rough guide, aim for time on water to be less than 6 hours. Aim closer to five hours if the wind is sustained above 18kn, or temperatures are less than 15C or higher than 30C (one hour prior to first scheduled warning until return to dock)
- Rigging and de-rigging the boat can require a team effort; help may be needed for just stepping the mast or for the entire procedure. It is the Sailors responsibility to supervise rigging of their own boats.
- Moving around the site is an important consideration. Mud, sand, soft or slippery surfaces are difficult for the less agile. Rough terrain can be hazardous for people with visual impairment. Ensure there is an accessible route between key locations – for example rigging areas may have pedestrian zones marked out through them.

To enable sailors to manage their own needs, including food, drink and medications, it is helpful if they know how long they can expect to be on the water.

Weather conditions often dictate the comfort and fatigue levels of someone who cannot move around much in the boat, or has poor temperature control. Rough seas and strong winds can toss a boat around to such a degree that those with reduced lower limb function or trunk control spend most of their time hanging on.

Visual impairment (VI) can vary from no vision at all to a useful condition where shapes and colours can be distinguished. Once, a skipper voiced some doubt about sending a capable, blind sailor to change a sail at night in dirty weather. He was told 'It's all the same to me, mate!'

Awareness in Race Management

Many, but not all, of the sailors racing in Paralympic and Hansa class boats have a physical disability, but it is important to be aware this has no bearing on their sailing ability. Sailing ability varies quite widely, from the very capable and experienced to the novice.

Physical disabilities can include anything from paraplegia and quadriplegia, to leg or arm amputation, cerebral palsy and stroke. Some people may have difficulty with verbal communication. Sailors with an intellectual disability or multiple disabilities may also be competing in these classes. Once again, ability will vary significantly.

As the Paralympic 2.4mR, SKUD 18, Sonar and Hansa class dinghies are ballasted keelboats, sailors with a disability do not have different limitations in terms of coping with wind and water conditions in comparison with able-bodied sailors of similar sailing ability.

Due to the potential for injury of the sailor and the safety crews if transferring afloat, it is recommended that sailors with a physical disability who are injured or unwell should remain in the boat where possible, and be towed to the dock where they can be transferred ashore using a crane or hoist.

The Race Committee should give special consideration to the communication needs of sailors with physical, intellectual or sensory disabilities in regard to conveying information (ashore and afloat), and signalling afloat. When in doubt, ask the sailors what they need!

It may assist during the competitors briefing to note that sailors with right of way may need to call earlier due to the possibility of delayed reaction times, limited manoeuvrability or the visual impairment of some sailors. Also, that while the audible call of "PROTEST" is required in accordance with RRS 61; a competitor may be unable to make such a call because of disability or similar reason.



Inclusive Regattas

As more clubs look towards including sailors with disabilities, and in particular, their local Hansa fleets, in club regattas, the following “cheat sheet” and hints are offered as suggestions when writing the Notice of Race, Sailing Instructions or on the day, to help regattas run as smoothly as possible. Not all of the following will apply to every event. Items in *italics* are suggested wording N.O.R and S.I. refer to the numbering in the standard YNZ template Acknowledgement to Helena Horswell

OOR and SI	Suggestion	Explanation
NOR 1.4 & 3.1 SI 1.4 & 1.7	<i>SKUD18 will be sailed in(X.X) configuration (specify J.1/J.2/J.3/J.4)</i>	SKUD 18 configuration Event Notices of Race may state in which configurations the SKUD 18 shall be sailed: <u>J.1. Open Two Person</u> - Two crew can hike, or if one sits in a centreline seat one can trapeze. <u>J.2. Open Three Person</u> - Three crew can hike, or if one sits in a centreline seat one can trapeze <u>J.3. Open Two Person Centreline</u> - Two crew both in centreline seats <u>J.4. World Sailing Two Person</u> - Two crew both in centreline seats, with additional provisions specified by World Sailing.
NOR 4	<i>The following classification requirements will apply (see rule 79): _____.</i>	This will usually only be used at Paralympic or other events that are not open to all competitors or have additional awards for sailors with classifiable disability.
NOR 12.2 SI 14.2	<i>For the Hansa classes RRS 44.1 and RRS P2.1 are changed so that the Two Turns Penalty is replaced by a One Turn Penalty.</i>	This is in line with many other classes, but it is also important to note that many sailors have less ability to quickly release and recover sheets, and servo boats are less responsive too. Also, with the forward facing seating in Hansa classes, and less neck movement or smaller stature of some sailors, it is difficult to check it is clear to start a turn (this may also cause some delay in taking a penalty).
NOR 16 SI 25	<i>Boats assigned places in the harbour shall not be hauled out during the regatta, except with and according to the terms of prior written permission of the race committee.</i>	Hansa class boats usually remain in the water for the duration of most regattas, due in part to the weighted keels and manpower resources required to launch and retrieve daily.
SI 1.5	<i>Racing rules will be changed as follows – Rule 41 is changed to allow the exception of assistance to Hansa boats with the following.....(specify) Rule 61.1 is changed to “shall hail ‘protest’ if sailor is able to”</i>	Suggested exceptions- seating adjustment, bailing, reefing, battery replacement, repair of servo equipment – these can all be regarded as safety issues, and the time taken to assist with these things would negate any competitive advantage achieved. If it is used, Sailing Instruction 23.1 will also need to be altered Some sailors are unable to hail protest

SI 2,3	Location of Notices to Competitors, changes to Sailing Instructions and Results	Notices to competitors, changes to Sailing Instructions and results should ideally be posted in an accessible location and at a height suitable for wheelchair users and those with smaller stature.
SI 4.2	Signals made ashore (time allowance)	It may take longer for people with disabilities to get into boats and leave the dock, especially if lifting equipment is required for a number of competitors
SI 6	Class Flags	Hansa classes may be run separately (class flags attached) or under one or more specified flags. If Hansa Class flags are not available, and substitutes are used, consider what colours are easily seen by Visually Impaired sailors.
SI 9	When describing course marks, consider allocating the tallest/largest marks or the least faded available to the Hansa courses, or making the course slightly shorter with more laps.	Class rules require sailors in Hansa 2.3, 303 Liberty and SKUD 18 (when sailed in some configurations) to remain seated and seats are low on the centreline of the boats. Sailors are also often smaller in stature or visually impaired, making it difficult to see smaller, more distant or older faded marks.
SI 15, 15.2	Target times	Some physical disabilities affect individuals' ability to regulate heat/cold, and intellectual disabilities may lead to a shorter concentration span so it is prudent to limit race times to no more than 60 minutes or 40 minutes in regattas for sailors with intellectual disabilities. Also, many sailors will find it challenging to remain on the water for extended periods for the same reasons, so the use of 15.2 is also suggested to lessen the time required between races. As a rough guide, aim for time on the water to be less than 6 hours, and reduce this further if wind is sustained above 18 knots, or temperatures are below 15c or above 30c
SI 16.6	Protest time limits (time allowance)	Suggest start time from when last boat ties up rather than from last boat finishing last race - often boats are dependent on being towed into a marina and then access to lifting equipment to leave the boat and get to area to lodge a protest.
SI 16.7	Protest room location	Location should be accessible, and large enough to accommodate a support person if required.
S18.1	Sign in/out sheet location	If sign in/out required, it is recommended that it be in a fixed, accessible location.
SI 23.1	<i>Except when requested to participate in rescue operations, or assisting Hansa classes, ...</i>	If sailing instruction 1.5 changes Rule 41 to allow assistance to Hansa boats, sailing instruction 23.1 should include assisting Hansa classes.

At The Sailor's Briefing.....at the Sailors briefing it is a good idea to emphasise to all sailors the importance to call for rights early if Visually Impaired or smaller sailors are competing, and that not all sailors may be able to hail protest, and abiding by the rules and taking penalty turns on the water is preferable to ending up in the protest room!

NZ Hansa Class Association Minimum Wind Speed Guideline

The recommended minimum wind speed for starting is that in which the race committee considers the boats have sufficient capability for pre- manoeuvres.

NZ Hansa Class Association Maximum Wind Speed Guidelines

Note: The following are guidelines only. The decision when to commence, continue or abandon a race is the responsibility of the race officials and should take into consideration local conditions, the ability of the sailors, fatigue levels and the capability of safety coverage. It is recommended that races should not start, or races in progress should be abandoned, when average wind strength or gusts exceed the speeds indicated in the table below, or the race committee considers conditions unsuitable for racing.

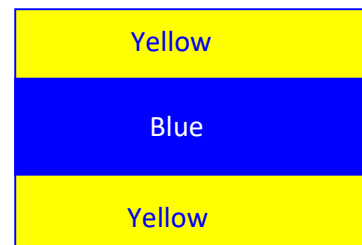
Class	Average Wind Strength		Maximum Gust
	Waves Less Than One Metre	Waves Greater Than One Metre	
Hansa 2.3	20 knots	16 knots	24 knots
Hansa 303	22 knots	18 knots	28 knots
Hansa Liberty	26 knots	24 knots	30 knots
SKUD 18	26 knots	25 knots	30 knots

Hansa Classes	Portsmouth Yardstick (PY) 2013	ACA (UK) Recommended PY Yardstick	Yachting Victoria Yardstick (YV) 2012 - 13	AHCA Recommended YV Yardstick	Sportboat Measurement System (SMS) Rating
2.3 Single Person	1925	1925	175	175	-
2.3 Single Person Full Servo	-	-	-	182	-
303 Single Person	1630	1630	166	165	-
303 Double Person	1660	1660	-	170	-
Liberty	1550	1550	132	140	-
Liberty Full Servo	-	-	-	145	-
SKUD 18 – Two Person,	1060	1660	-	113	0.685
SKUD 18 - Two Person, Open	-	-	-	110	0.704
SKUD 18 - Three Person,	-	-	-	108	0.715
Comparative Class					
29er	922	-	96.5	-	-
International 2.4mR	1250	-	137	-	-
International Cadet	1432	-	153	-	-
Laser	1087	-	113	-	-
Laser 4.7	1180	-	122	-	-
Mirror	1385	-	143	-	-
Optimist	1648	-	166.5	-	-
Flying Fifteen MkI	1020	-	109	-	-
Flying Fifteen MkII	1020	-	112	-	-

Safety Ideas

Use of Flag D

Flag D is a safety flag used to hold boats ashore until the race committee has safety vessels on the water and is happy that racing will proceed. It needs to be in the Sailing Instructions. When this flag is displayed boats are permitted to leave the shore.



The standard wording in Appendix L 4.2 is:

Flag D with one sound means “the warning single will be made not less than ____ minutes after flag D is displayed. [Boats are requested not to leave the harbour until this signal is made.]

A better version is:

A boat shall not leave the shore until flag D is displayed ashore. The warning signal will not be made before the schedule time or less than --- minutes after flag D is displayed.

Flag D is useful when the boats leave from the same place close to the place where signals are made ashore.

Safety vessels

Care must be taken by the Organising Authority to ensure that there are sufficient safety vessels available, of a size commensurate with the likely emergency requirements, maintained to industry standards and crewed by at least two people with sufficient experience and knowledge to handle any situation which might develop. There are no definitive rules about the number of such vessels required. For many club situations, on a reasonable day, a ratio of 1 safety vessel for every 10 race boats is likely to be sufficient. For learn to sail situations a ratio of 1 safety vessel for every 6 race boats may be more prudent. When taking junior sailors into unfamiliar situations 1 safety vessel for each sailor may be required.

Clubs should have an ongoing programme of training of safety vessel crews and practice this training in normal club events. For instance, sailors and safety boat crews should undertake tows, assist coming alongside a capsized boat and assist righting boats.

See <https://www.youtube.com/watch?v=OuMJ2ExA79k> for a video by the Swanage Sailing Club

Watch Boats

In many junior regattas there are often a number of club, individual sailor coach or support vessels. Rightly, sailing instructions often require these vessels to be outside the area in which the racing boats may sail. At the Optimist Nationals in 2014, each fleet had two Watch Vessels designated to be inside the course area watching the fleet and being the first response should a racing boat appear to be in difficulty. If the racing boat required assistance the watch vessel would render immediate assistance and would call in the club or personal support vessel for further assistance. The Watch Vessel would then continue its duty watching the remainder of the fleet. While this system requires preplanning and cooperation of the individual support vessels or visiting club support vessels it is an idea worth pursuing.

Links to assist developing a Safety Plan

Sport New Zealand

<http://www.sportnz.org.nz/managing-sport/guides/health-and-safety-for-clubs>

Yachting New Zealand Club Manual (Section 6)

<http://www.yachtingnz.org.nz/clubs/club-manual>

AYBA

<http://ayba.org.nz/Safety%20Plans/Riskmanagementsafetyplansforclubs.pdf>

Whatever plan you develop it is there to include all practical steps to ensure the safety of everyone. We think it should include:

Explanation of the devolution of responsibility

Explanation of how those responsible will know of their responsibilities

Explain the procedures to ensure those responsible know the whereabouts of everyone at all times

- Check out/check in
- How the fleet(s) will be monitored during and after the race
- Procedures when a boat capsizes
- Procedures for a missing sailor
- How all regatta staff are accounted for

Outline the hazards and the mitigations of those hazards

Explain the procedures when things go wrong:

- Single person – equipment damage, injury, sickness or lost
- Multiple incidents at the same time
- Inclement weather – visibility, temperature, strong winds, large waves
- Methodology for liaison with emergency services and transfer of a patient to them.

The plan may well be separated into land based and water-based plans.

On the Water Safety and Emergency Plan Example

The following is an example of an On the Water Safety and Emergency Plan for an event with two course areas one with a windward leeward course of 60 racing boats and the other a trapezoid with beat to finish course for about 150 boats. The plan can be adapted for more or less courses or a different number of competitors. More important than having a plan is ensuring that it is shared and understood by all who are affected – sailors, race committee personnel, on the land helpers and safety vessel crews.

1 Responsibilities

Competitors

- To attend the Briefing
- Make their own decision whether to race
- Complete Check out Check in procedures
- Understand What to do if they require help on the water. Competitors who require assistance should wave one arm with hand open. If no assistance is required, the arm should be waved with fist closed.
- What to do in adverse visibility
- What to do in foul weather

Principal Race Officer (the course race officer in a single course area event)

- Obtain and promulgate Weather forecasts
- With the race officers and safety officers make the decision whether race
- Organize and run Briefings for:
 - Competitors
 - Course Race Officers
 - Equipment team
 - Shore personal
 - Jury
 - Beach Master and team
 - Bridge and course radio operator
 - Results team
- Develop, promulgate and follow the Emergency plan
- Oversee the day to day running of the event.

Safety Officer

- Lead the safety vessel team.
- Liaise with the Principal Race Officer, course race officers and each course's safety leaders
- Oversee single incident events and rearrange resources accordingly
- Assume control of safety incidents involving more than one competitor or where resources need to be reallocated.

Course Race Officers

- Decision to race
- Lead daily briefing with the on the water Race Management team
 - Signal Vessel, Start Pin, Mark Vessels, Finish and Finish Pin
 - Safety vessels
 - Gear vessels
- Lead the race management team for that course area
- Apply race management policies as outlined in pages 26 – 34 of this Race Management Guidelines book
- Monitor the fleets

- Liaise with Safety leaders and Safety Officer to ensure everyone is safe

2 The Weather

Forecasts will be obtained from: Metservice, Metvuw, Windy and Predict Wind

Wind measurement during the day

- From anemometers fixed or handheld on the race committee signal vessels
- From Mark boats measuring direction and speed every 5 minutes using hand held anemometers and hand bearing compasses

Wind limits for racing – as per World Sailing policies lower wind speed 4 knots, upper wind speed 25 knots or pre-determined speeds from the class association(s) involved in the regatta

3 On the Water Procedures

Overall safety management is the responsibility of the Safety Officer. The safety of each course area is the responsibility of the Course Race Officer in conjunction with the Safety Leader from the time the first race management vessels go afloat until all boats are off the water or anchored at a suitable overnight anchorage.

The approximate positions of the course areas are shown in Addendum A. (Not included in this example)

4 Race Management

Course Area Alpha	Course Area Bravo
Alpha Signal	Bravo Signal
Alpha Start Pin	Bravo Start Pin
Alpha Mark1	Bravo Mark 1
	Bravo Mark 2
	Bravo Mark 3
Alpha Mark 4	Bravo Mark 4
	Bravo Mark 5
Alpha Finish	Bravo Finish
Alpha Finish Pin	Bravo Finish Pin
Alpha Safety 1	Bravo Safety Leader
Alpha Safety 2	Bravo Safety 2
Alpha Safety 3	Bravo Safety 3
Alpha Safety 4	Bravo Safety 4
Alpha Safety Leader	Bravo Safety 5
	Bravo Safety 6
	Bravo Safety 7
	Bravo Safety 8
Jury 1	Jury 1
Jury 2	Jury 2
	Jury 3

The primary method of communication on the water will be by VHF. A mobile phone list will also be available on each race committee boat.

Course Area	VHF Channel
A	77
B	17

All vessels will be crewed by at least two people who have experience at club level. Vessels will be allocated positions on the racecourse according to the diagrams in Addendum B. A briefing of the skippers of race management vessels and the Course Race Officer and the safety vessels and gear vessels with the Safety Officer will be held each morning before racing.

The course race officers in conjunction with the Principal Race Officer and the Safety Officer will consider whether conditions are appropriate for racing. He/she will inform the other race committee vessels when racing will take place with the approximate location of the racing area.

All race committee vessels will check in with the bridge and the race committee signal vessel as soon as they leave the shore. This transmission should confirm the number of crew and any changes to the roster.

The Course Race Officer will confirm with the Principal Race Officer through the Bridge that racing will proceed and the time that Flag D should be displayed ashore. The Principal Race Officer will ensure that sufficient safety vessels are on the water ready to escort the fleet to the racing area prior to Flag D being displayed. Flag D may be displayed over a course area flag or fleet class flags to ensure that launching is managed in an orderly fashion. The Safety Leader of each course area will designate which vessel will shepherd those leaving the beach first and which safety vessel will be designated to escort the last that leave the beach. The remainder of the safety vessels will be spread throughout the fleet.

Bridge via the registration team will supervise the check-out procedure and inform the signal vessel of the number of boats that leave the beach and the sail numbers of those that remain ashore. Bridge will communicate with the signal vessel the time of the first and last boats to leave the beach.

Safety vessel skippers will be required to wear a high visibility vest with their safety vessel number clearly visible on it. Mark vessel and safety vessel will carry the equipment in the following list.

Life jackets for each crew member
Bungs (and spare)
Anchor chain and warp
Tow rope
5 yellow "crew Safe" ribbons
Bailer (Bucket and lanyard)
Tools, shackle key on float and a sharp knife
First Aid Kit and sunscreen
VHF Radio
Clipboard, pencil and list of competitors
Fuel
Food and drink

It is recommended that one of the crew should be dressed to enter the water to aid rescue. When the engine is running, the driver shall be connected to a device that will stop the motor if the vessel driver falls out of the vessel or is otherwise not in control of the vessel. Personal floatation devices must be worn at all times except, briefly while changing or adjusting clothing or personal equipment, for all vessels six metres or less in overall length.

When racing begins the Safety Vessels will take up positions between their allocated position and the racing boats. In general, odd numbered Safety Vessels patrol the left-hand side of the course and the even numbered vessels the right hand side. Safety Vessels should keep their speed down and not travel at the same speed as the sailors. In normal circumstances, all race management vessels will keep clear of the racing boats usually no closer than 50 m from the area that boats are racing. While the primary responsibility for the safety of racing boats is the Safety Vessels, the Mark Vessels and other race management vessels will also share that role if required.

During racing mark vessels will be stationed at the mark that they lay. A sequential list of boats rounding each mark will be recorded and this tallied with the entry list. Any discrepancy should be communicated to both Bridge and the Safety leader. Keeping track of the racing fleet is a significant part of the safety plan.

Safety and mark vessels should be vigilant in watching the fleet and responding to anything unusual. For instance, flapping sail, a boat sailing haphazardly or a capsized boat. In the first instance a check should be made that the sailor is attempting to remedy the situation. If that is the case then it is likely that no further action will be needed but sometimes approaching this boat and standing by will be the best course of action. If the boat is capsized then the nearest safety vessel should proceed to stand by close to the capsized boat. Assistance will only be given if the competitor requests help or if the situation makes it obvious assistance is required. Competitors who require assistance should wave one arm with hand open. If no assistance is required, the arm should be waved with fist closed.

If the sailor cannot be seen a safety vessel will proceed to the boat as quickly as is prudent being mindful of the safety of the rest of the fleet. Remember the first thirty seconds in a response where life is in danger is the most important.

If illness or injury requires a sailor to be taken ashore immediately, tie a yellow "Crew safe" ribbon through the bow eye, tell Bridge and the safety leader that you need to bring a sailor ashore urgently. Tell Bridge about the injury or illness so the relevant emergency services can be informed.

Procedures for boats returning ashore.

Safety vessels will escort the boats returning to the beach and standby. On the beach the registration team will independently create a sequential list of boats returning to the beach. This list should be tallied with the entry list. Once it appears all boats are ashore, any discrepancies should be resolved by checking the competitor check in tallies and if there is still a discrepancy by using the PA system to identify the sailor(s). When all boats are accounted for Bridge will inform the Race Officer who with the Safety Leader will release the safety fleet to come ashore.

Procedures for boats retiring

Boats that retire from a race or return to the beach should notify either a race management vessel if practicable or Bridge immediately they get ashore. The race committee vessel or Bridge will immediately inform the signal vessel, safety leader and the registration team so the boat is accounted for in the check in procedures.

If a boat is disabled and requires a tow back to shore a race management boat should inform the signal vessel of this requirement. The race officer will determine whether it is safe for this to proceed or will make some other arrangement for the disabled boat. (e.g. anchored or tided up behind an anchored vessel until the overall safety of the fleet allows release of a vessel to undertake the tow)

Procedures for a boat in distress

- Approach and account for all crew
- Stand off to windward, stern to the wind
- Ascertain whether the crew require assistance
- Encourage sailor to right the boat
- Collect up loose gear which may be floating around
- If required to assist approach the bow of the boat with your stern to the wind holding position with minimal use of motor.
- Assist righting the boat (use forestay if possible) keeping the yacht's bow to windward
- When holding or approaching an upright boat make contact on the windward side alongside the mast.
- Help hold the boat almost head to wind (slightly to one side so the boom is clear of the cockpit and safety vessel) whilst the skipper bails the boat out.

Procedures for towing

- Do not offer a tow unless specifically requested to do so by the race officer. If whole of fleet towing is to be allowed, flag T will be displayed either on shore or on the race committee signal vessels.
- If possible drop the mainsail
- Bail out the worst of the water
- If possible, have the sailor in the boat to steer
- Thread a towrope through an eye on the bow, loop around the mast and give to the sailor to hold on to – for quick release.
- Lift the centreboard
- Tow slowly (less than 8 knots) so as not to cause the boat to capsize, adjust length of tow to be on the back of the wave behind the vessel
- Be aware of exhaust fumes affecting the sailor
- Keep a watch on the towed boat at all times

Adverse weather

At the start of the regatta, all race management vessels should enter a GPS waypoint of the water just off the shore in front of the clubhouse and another due east of the ramp outside the bay. Care will still need to be taken with the reefs extending on both the northern and southern sides of the bay.

If adverse visibility arrives prior to a race, racing will be postponed (AP) and the safety and mark vessel will endeavor to keep the sailing boats close together centered on the starting area. If conditions are expected to remain then AP/H will be displayed to take the fleet ashore.

If adverse visibility arrives during a race such that racing is unsafe or unfair the race will be abandoned RRS 32.1(e) (N/H or N/A). Boats will be informed at each mark or the finish and will be requested to stop and stay close to the mark or safety vessel. These boats will be counted and Bridge and the race officer informed how many boats they have. If all boats are accounted for then each group will proceed ashore with boats keeping in sight of each other at all times. Towing may be appropriate. If some boats are unaccounted for a search will commence using some of the safety vessels.

If a competitor cannot see a race management boat or a reference point they should stop, stay with any other boats they can see and use a whistle to attract attention.

Strong winds.

If strong winds arrive before racing, the race will be postponed and competitors will be sent ashore (AP/H). If strong winds arrive during racing making the race unsafe or unfair the race will be abandoned (N/H or N/A). This signal will be duplicated on mark vessels. Safety vessels and mark vessels will gather up a group of about ten boats and escort them back ashore. Jury, and gear vessels will bring up the rear noting in particular any boats that slow or who get isolated from their group. The signal vessel will remain on station until all boats are ashore and accounted for.

Unconscious Sailor or one with significant injury – Code Red

Immediately inform the Race Officer and safety leader of your position.

e.g. Code Red, Code Red, this is Safety Boat X position right hand side of the course two thirds up the beat (for instance) three times

At the same time ensure the sailor's head is clear of the water, this may necessitate one of the safety vessel crew going in the water. Carry out whatever else can be done, if possible get the sailor aboard the RIB.

The Code Red call will be responded to by the safety leader dispatching another safety vessel to the scene or in the case of the safety leader making the code red call by the race officer dispatching another safety vessel or a mark vessel to the scene.

Sailor missing - Code Red

A Yacht without a Sailor is an Emergency

If the yacht is capsized, right the yacht to ensure the sailor is not trapped underneath.

Immediately visually scan the area and pair up sailors with their boats.

Drop a marker buoy and secure the yacht to the buoy if available.

Press the MOB function on your GPS if you have one.

DO NOT put a "Crew Safe" TAPE on the yacht until the sailor is positively identified as being safe and the sailor's location is known.

Advise Bridge and the Safety Leader "Code Red, Code Red, Sailor Missing, Sailor Missing."

Give an accurate position with reference to course marks and report the boat number.

Start a hasty search up wind over a 60° triangle from the mark for a distance of 200 metres. Safety vessel crew standing if possible. Check other boats for more people than they should have on board. Then start downwind from the buoy a hasty search over a 60° triangle for 100 metres, Safety vessel crew standing if possible. Check other boats for more people than they should have on board.

The Safety Leader (or the Race Officer) will dispatch other available safety vessels to the area immediately. The Safety Leader will request other resources from other course areas.

If this is unsuccessful the race will probably be abandoned with N/H. Race officer will determine the vessels required to shadow the fleet home. All other vessels will join the search.

Bridge will advise the Principal Race Officer who will advise Maritime Police.

A Mark Laying vessel will take GPS co-ordinates of the yacht or marker buoy and co-ordinate grid search as directed by the Safety Leader. Any spectator vessels will be utilised. Form a line abreast

20 metres apart 200 metres downwind and centred on marker buoy, safety vessel line to sweep upwind to top of course area.

If unsuccessful form up line abreast co-ordinated by safety vessel leader and assisted by all other available vessels sweep whole course down wind.

During this period Bridge will reconcile check out and check in tallies sheets and physically check sailors ashore to verify the sailor missing.

If still unsuccessful form up at right angles to the course and sweep course again.

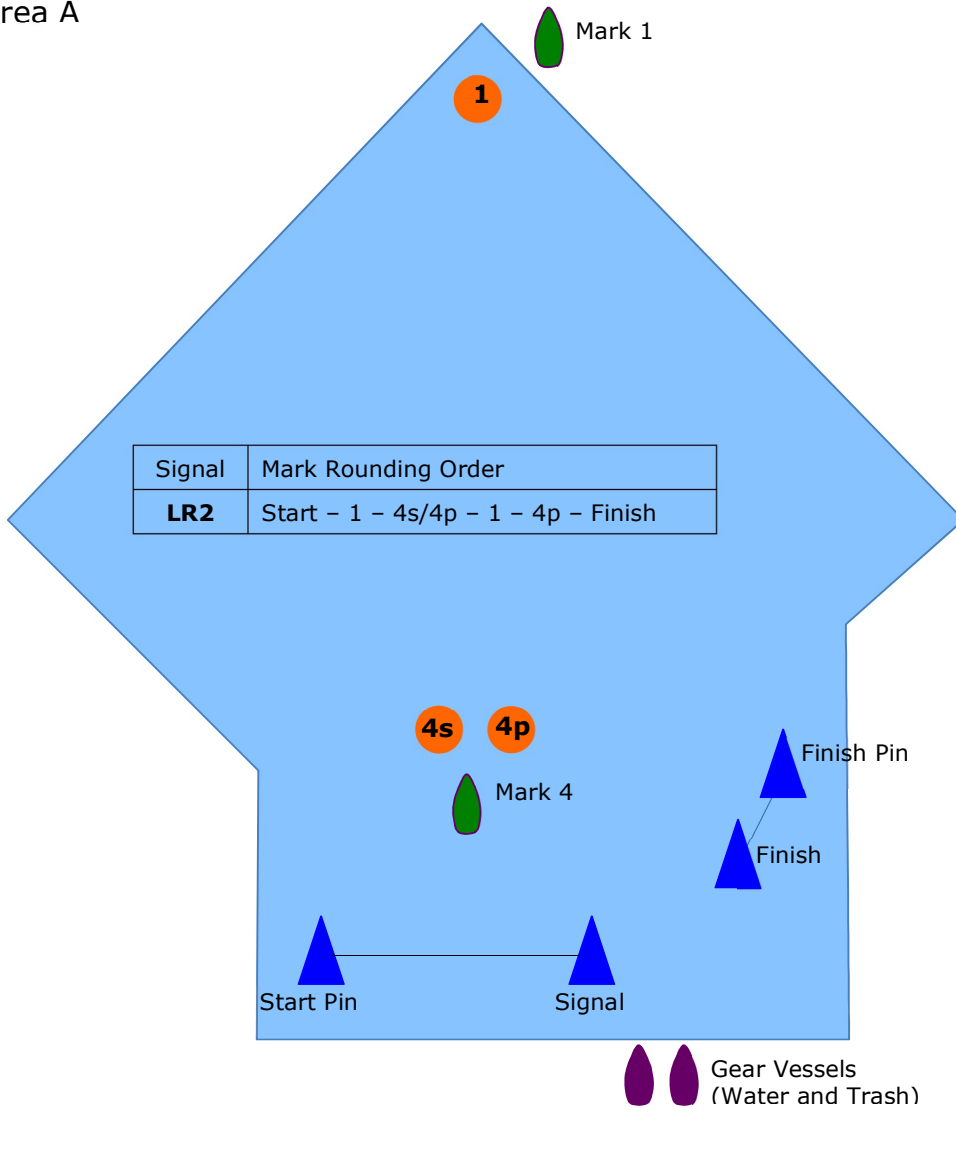
If still unsuccessful form up at the top of the course and sweep down centred on the marker buoy.

Search to continue until successful in conjunction with the Maritime Police.

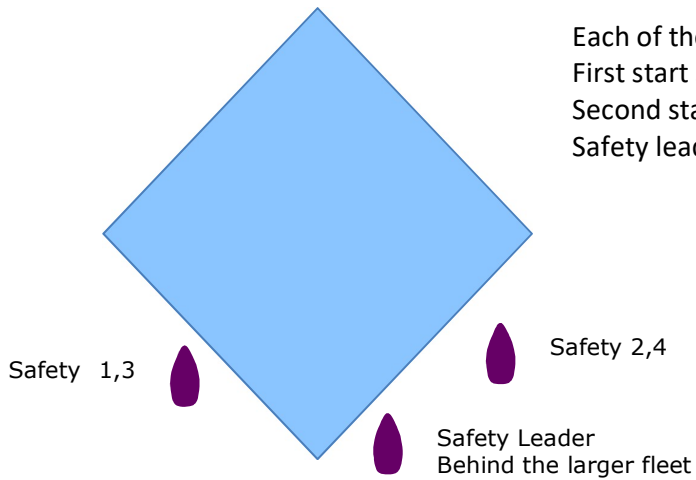
Debrief in conjunction with the authorities.

Addendum B

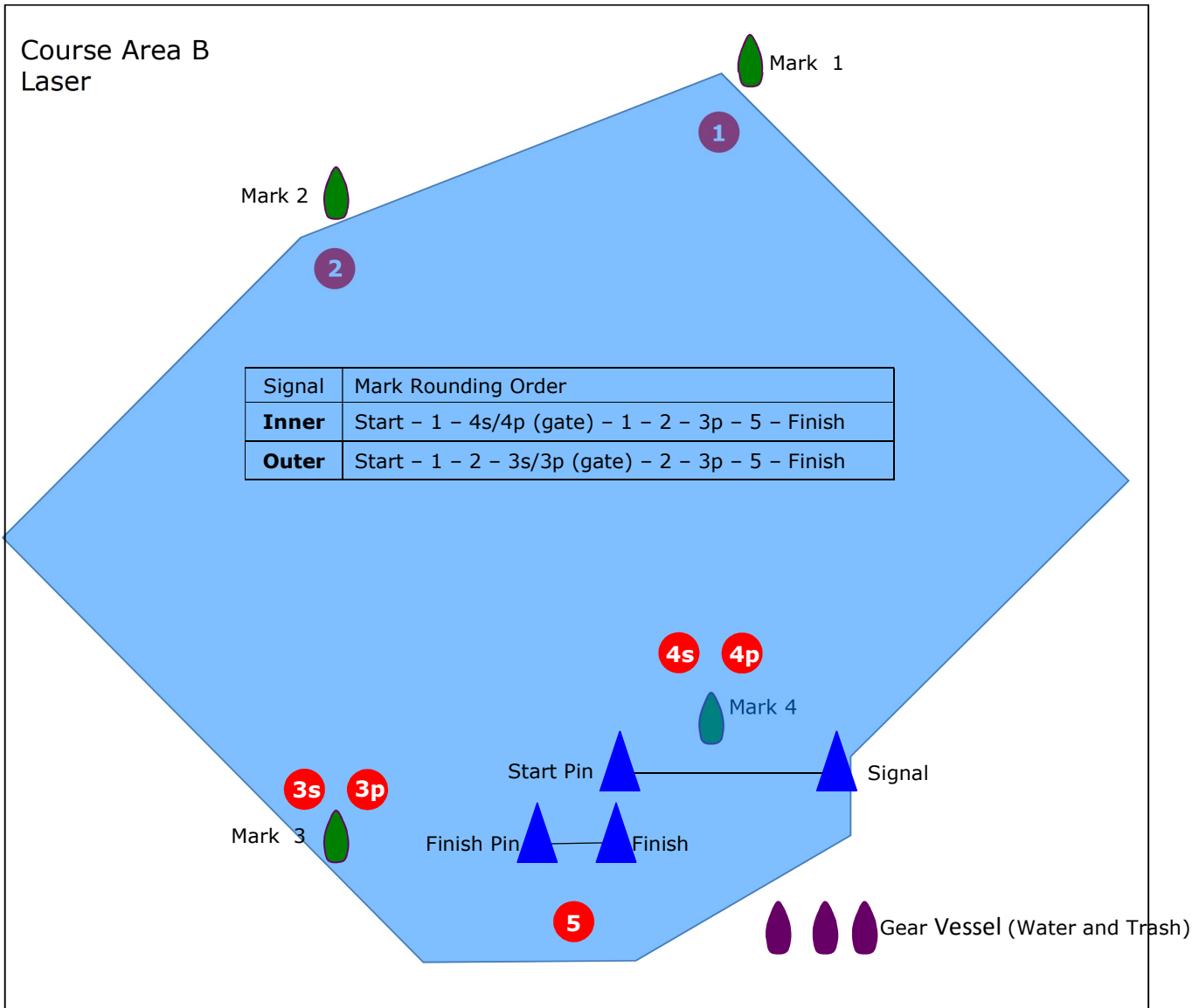
Course Area A
Weta



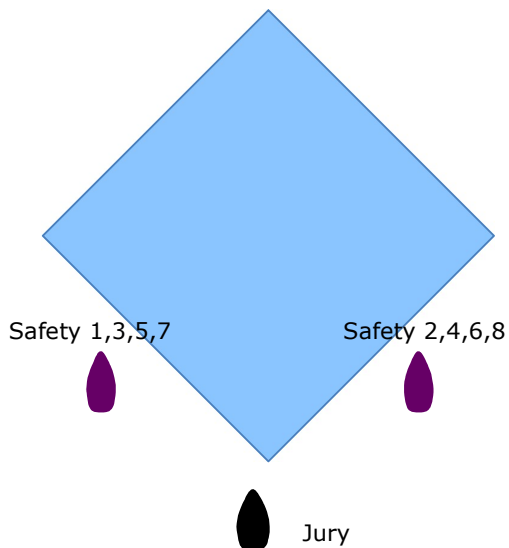
Position of the safety vessels relative to the fleet



Each of the two fleets will have two designated safety vessels
 First start Safety 1 on left and Safety 2 on the right
 Second start Safety 3 on the left and Safety 4 on the right
 Safety leader to follow the larger fleet



Position of the safety vessels relative to their fleet



Each of the four fleets will have two designated safety vessels
 First start Safety 1 on left and Safety 2 on the right
 Second start Safety 3 on the left and Safety 4 on the right
 etc

Safety vessel Plan

- Every safety vessel to be crewed by at least two people and have the required equipment on board.
- Launch prior to the sailors. Check launch time with RO prior to the event.
- Escort boats to the starting area. Do not offer a tow unless specifically requested to do so by the RO.
- Complete a radio check with Shore Base AND with the RO on the Race Committee Signal vessel.
- Take up your designated station and follow the fleet.
- Keep a safe distance from the racing boats. Follow their path up and down the course by being between the sailors and your designated area. Keep your speed down and do not travel at the same speed as the sailors.
- Keep a good lookout for boats in trouble, capsized boats and boats that appear to have stopped racing.
- Immediately motor towards any capsized or disabled boat and observe the actions of the sailors. Ensure you can count heads of the number who should be on board. Move quickly if you cannot immediately account for all the crew.
- Standby capsized boats but do not assist unless either asked to do so or help is needed because there is danger to life.
- Report to the RO if help is required or there is more than one capsized boat.
- Inform the RO if any boats appear to be sailing back to shore or back to the starting area.
- Encourage the sailor to sail the boat ashore him/her self.
- Request permission from the RO before towing a boat to ashore.
- At the end of racing follow the fleet from your designated area to the finish and escort the fleet ashore. Ensure all boats are ashore before hauling out. Request clearance from the RO.

How to do a Rescue

- Approach and account for all crew
- Stand off to windward, stern to the wind
- Ascertain whether the crew require assistance
- Encourage sailor to right the boat
- Collect up loose gear which may be floating around
- If required to assist approach the bow of the boat with your stern to the wind holding position with minimal use of motor.
- Assist righting the boat (use forestay if possible) keeping the yacht's bow to windward
- When holding or approaching an upright boat make contact on the windward side alongside the mast.
- Help hold the boat almost head to wind (slightly to one side so the boom is clear of the cockpit and safety boat) whilst the skipper bails the boat out.

Equipment

- Life jackets for each crew member
- Bungs (and spare)
- Anchor chain and warp
- Tow rope and 5 yellow ribbons
- Bailer (Bucket and lanyard)
- Tools, shackle key on float and a sharp knife
- First Aid Kit and sunscreen
- VHF Radio
- Fuel
- Food and drink

Towing

- If at all possible have the sailor in the boat to steer
- Drop the mainsail
- Bail out the worst of the water
- Loop tow rope around the mast and give to the sailor to hold on to – for quick release.
- Lift the centreboard
- Tow slowly to not cause the boat to capsize, adjust length of tow to be on the back of the wave behind the boat
- Be aware of exhaust fumes affecting the sailor
- Keep a watch on the towed boat at all times

Removal of crew from a boat – injury or safety issue

- If a boat is left with no crew, tie a yellow (Crew safe) ribbon on the bow fitting, to inform someone else that the crew have been accounted for. Inform the RO and Shore Base.
- Ascertain the injuries and make the patient comfortable – liaise with Shore base about the best course of action.
- Whole Fleet Emergency – foul weather
- In the event of danger to life a race will be abandoned. The safety co-ordination will be transferred to Shore Base. The Race Committee Signal vessel will remain anchored or move to a more suitable position to co-ordinate with Shore Base. It will accept sailors on board and will tie boats up behind to speed up the process of ensuring everyone is accounted for.
- Safety boats will, in the first instance, provide support in their designated areas. If necessary, request further assistance. When their area is clear seek advice from Shore Base as to which area to cover.

Radio Blackout

- Deal with immediate emergencies in your area and visibility.
- Consider which is the quickest way to report your actions – another boat that may have communications, the Race Committee Signal vessel or Shore Base - whichever is most helpful to continue safety work.

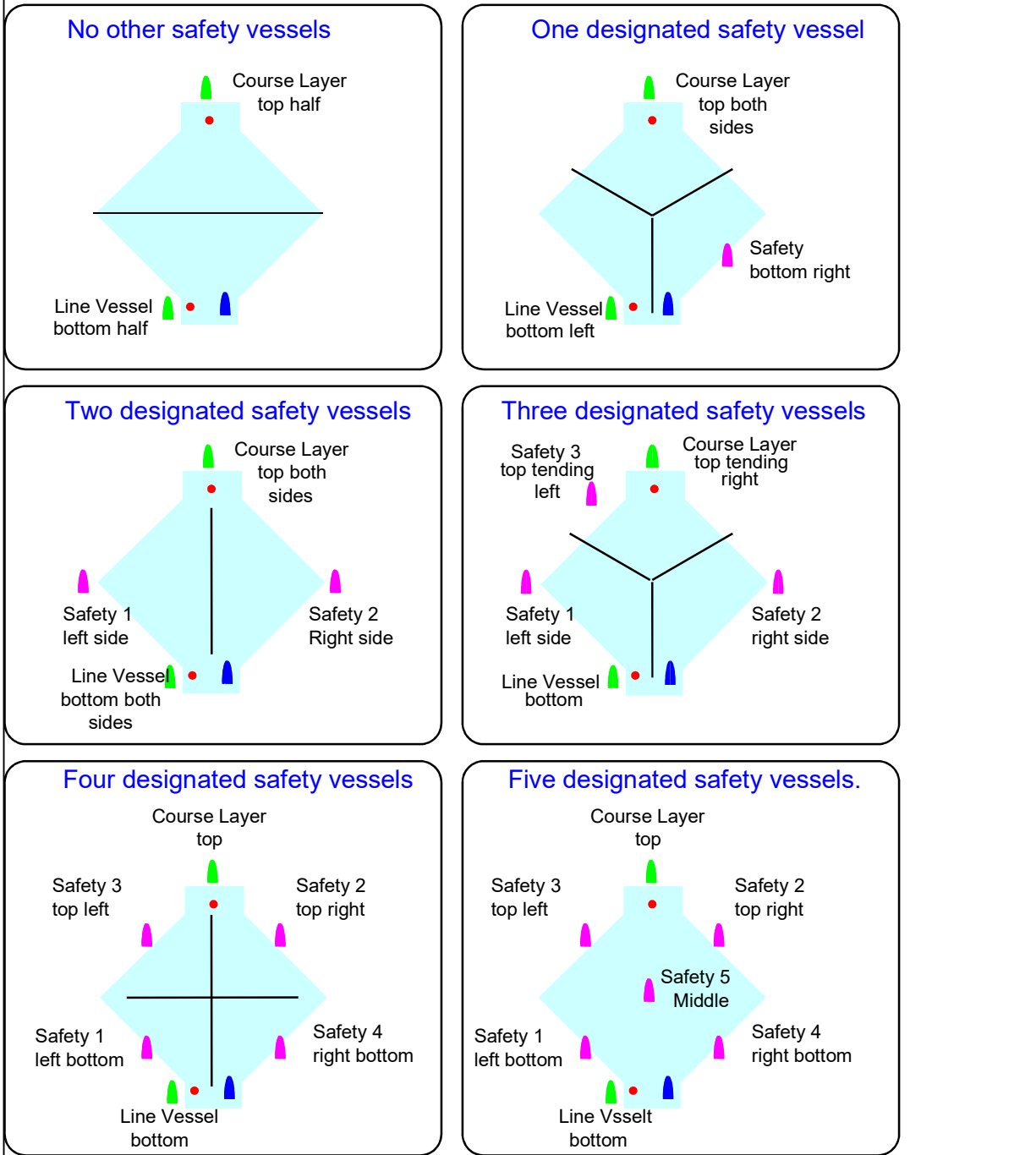
Crewless Boat and No Yellow (Crew Safe) Ribbon

- Immediately communicate with RO (or Shore Base if an emergency has already been declared).
- Stop and scan everywhere. Check that the sailor is not trapped under the boat or under the sail.
- Consider the line of drift (wind and tide). Scan more carefully both ways on this line.
- Search upwind over a 60° triangle from the boat to a distance at least 200m. Safety vessel crew standing if possible.

- Once other vessels arrive make a line abreast (20m apart) search from 200 m downwind of the boat into the wind.

Zones for Safety Boats

It is best if the Race Committee Signal Vessel, Course Layer and Line Vessel are able to concentrate on race management and are not part of the safety vessel scheme. These Race committee vessel should then become extras in the event of an emergency.



Unless undertaking a rescue or standing by a capsized or disabled boat safety vessels should follow close to the fleet of boats keeping themselves between the fleet and their designated area.

The following is an example of the procedures for safety inspections

(Acknowledgement to Royal Port Nicholson Yacht Club)

PRINCIPLES

- Safety inspections should be designed to promote safety.
- Safety inspections should have an educative component.
- The items inspected should mainly represent high value safety items (eg: lifejackets).

PROCEDURE

- Sailing instructions are to be modified to support this plan. In particular, the SIs will provide that a breach of safety that has been detected by a safety officer in the course of a safety inspection shall not be grounds for protest by a boat. This will allow the race committee to publish the details of warnings given without fear that the boat will be protested by another competitor.
- At least three yachts are to be chosen at random prior to racing each day.
- Each yacht randomly chosen to be inspected, and each boat to be rechecked, is to be advised (by a safety boat by VHF) that it will be inspected.
- A safety officer will meet each boat at its berth as it arrives. Each boat will be required to produce certain safety equipment to the safety officer. The list of items will not be disclosed to boats prior to inspections. The list of items may vary from day to day and from boat-to-boat.
- The safety officer shall report his findings to the RD.

NON-COMPLIANCE

- Non-compliance with safety regulations is a breach of the rules and can be protested.
- Not every instance of non-compliance demands protest action:
 - Insignificant, inadvertent, technical or trifling breaches of the safety regulations ought not be the subject of protest action. Such breaches must be remedied and boats rechecked on the next race day. Examples of insignificant, inadvertent, technical or trifling breaches may include:
 - flares or fire extinguishers being less than 1 month beyond their expiry date;
 - a full flare kit, less one flare;
 - carrying sufficient buckets but of incorrect capacity;
 - not having the yacht's name marked on lifejackets that are the property of crew
 - Significant breaches of safety (into which category most breaches are likely to fall) and repeated insignificant breaches should be protested except in exceptional circumstances. Examples of significant breaches of safety include:
 - not carrying a suitable first aid kit, VHF radio or life buoy;
 - carrying too few lifejackets or insufficient fuel;
 - not carrying the correct fire extinguishers or not having them in the correct location;
 - A second or subsequent breach during the regatta, breaches which result in the boat obtaining a material advantage or a refusal to be inspected should either be the subject of a rule 2 protest or a rule 69 report.

SAFETY INSPECTION WORKSHEET

Boat Name:		Date	
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ITEMS INSPECTED

Ref	Item	Expected Standard	Observation
14.8	Fuel	<u>LWL(m)</u> 0.4	
9.2 9.3	Fire extinguishers	<p>“Fire extinguishers, at least two, readily accessible and visible in suitable and different parts of the vessel”</p> <p>“Fire extinguishers shall be serviced/tested at the time intervals specified by the manufacturer”</p>	
9.7	Buckets	“ Two buckets of stout construction each at least 9 litres (2 galls) capacity. Each bucket to have a lanyard.”	
10.1	Anchor	<p>“One anchor only”</p> <p>“A cable of 6m (19 ft 6in) minimum of chain plus 40m (130 ft) of rope or chain”</p> <p>“Note: At least one anchor must be complete with tackle and ready for immediate use at all times”</p>	
NOR 1.2	Misc	VHF Transceiver Bosun’s chair Chart NZ4633	
13.1	Lifejackets	“ Life jackets , one for each crew ... NZS 5823:2001 type 402 or its equivalent”	
13.1 0	Flares	<p>“Distress signals... to be stowed in a waterproof container...</p> <p>...two red hand flares... (one with VHF/cell)</p> <p>...two orange smoke day signals... (one with VHF/cell)...”</p>	
9.9	First Aid	SR appendix 1	
13.7	Liferaft	Vessels must carry an additional lifebuoy and equipment in accordance with safety regulation 13.9(b).	

RESULT OF INSPECTION

Complied	
Insignificant or trifling breach	
Significant breach	
Repeated breach	

(Name of Safety Officer)

Race Management Policies for Round the Buoys Regattas

This document is written as our current thinking on the decisions which may need to be made by the Race Management team at a typical regatta in New Zealand including national championships for dinghies and keelboats.

John and Linda Parrish June 2017

See also World Sailing Race Management Policies for World Sailing Events (Fleet Racing)

http://www.sailing.org/raceofficials/internationalraceofficer/document_library.php

The purpose of these policies is to ensure quality race management that is predictable, consistent and fair. The following policies indicate the intentions of the Race Committee. They do not form any part of the Notice of Race or Sailing Instructions. Failure to apply the guidelines will not be grounds for redress.

These guidelines should be discussed, and modifications agreed, with the class associations concerned prior to the commencement of the regatta. Some class associations may well wish to alter the criteria for abandonment for large wind shifts, for collapse in wind strength or for strong winds.

Anything in italics is considered useful to the race management team only and would have no value to be included in a document posted on the official notice board.

1 Definitions

- 1.1 **Principal Race Officer** – responsible for the conduct of racing on all course areas for multicourse regattas. Usually based ashore.
- 1.2 **Course Race Officer** – responsible for managing the race management team for an assigned course area.
- 1.3 **Race Management Team** – all on the water personnel responsible for managing racing.
- 1.4 **“Will”** means the intentions of the race management team.

2 General Principles

- 2.1 The roll of the race management team is to facilitate racing and to conduct the races as directed by the organising authority as required by the rules.
- 2.2 These policies are applicable for any course and any target time. Creation of different courses is to be encouraged.
- 2.3 A shortage of time or completed races is not a basis for variation from these policies.
- 2.4 The operator of a race management team vessel will promptly advise the Course Race Officer if he/she believes his/her vessel has substantially affected one or more boats racing.

3 Briefing

- 3.1 All racing details are contained in the Notice of Race and Sailing Instructions. Any changes to Sailing Instructions will be posted on the Official Notice Board in the manner and time specified in the Sailing Instructions.
- 3.2 Any questions about the Notice of Race or Sailing Instructions are required in writing. An answer will be posted on the notice board for all to see. A briefing will be restricted to outlining Race Management expectations regarding the smooth running of the event and informing sailors of venue specific hazards and safety concerns.
- 3.3 A briefing of race committee personnel will be organised by the Race Officer prior to the first day of racing to outline duties and expectations.

5 Radio Communication where boats are required to carry VHF radios.

- 5.1 Timing information including countdowns for starting signals will be made over a designated VHF channel.
- 5.2 OCS information will be broadcast as soon as possible after the start when flag P is used as the preparatory signal. (needs a suitable Sailing Instruction clause)
- 5.3 Other race information, postponement, abandonment, shortening, changing and time of next race will be broadcast.

6 Times

- 6.1 Times will be based on GPS time.
- 6.2 It is the intention of the Race Committee to start on time. The start will not be delayed for competitors to reach the race area if they could have arrived with reasonable diligence.
- 6.3 To alert boats that a race or sequence of races will begin soon, the orange starting line flag will be displayed with one sound at least five minutes before a warning signal is made.
- 6.4 The orange starting line flag(s) will be removed with no sound signal four minutes after the starting signal unless the race management team intends to make the warning signal for the next fleet to start within five minutes of the previous start.
- 6.5 Subsequent back to back races will be started as soon as practicable but not before 5 minutes after the last boat has finished the preceding race or 5 minutes after the last time for a boat to finish if boats are still racing, whichever is the earlier.
- 6.6 The entire day will be used if necessary to complete the schedule.
- 6.7 If adverse weather is forecast the schedule may be changed to sail more races in a day. The number of races sailed will not become more than one race ahead of schedule and any change will be notified on the day before it is to take effect.
- 6.8 For venues where boats launch from a single area close to the clubhouse Flag D should be used to control the time boats may go afloat. Safety boats should be launched before Flag D is displayed. Under normal circumstances Flag D should be displayed at a time that allows adequate pre-race practice (probably 75 minutes prior to the first warning signal). This time will be influenced by the distance from the launch area to the race course.

7 Wind speed measurement

For the purposes of starting or abandoning races:

- 7.1 Wind will be measured from drifting vessels.
- 7.2 Wind speed measurements should be taken with an anemometer from between 1.5 and 4 metres above the surface of the water.
- 7.3 When an average wind speed is required it will be measured over a five-minute period in one of these ways:
 - (i) by the hand-held anemometer's averaging facility if available; or
 - (ii) by taking 10 instantaneous measurements every thirty seconds and averaging these.
- 7.4 Wind readings will be taken in as many places around the racing area as possible.

8 Current (Tide) Measurements

- 8.1 Current measurements will be taken wherever possible at 15 minute intervals.

9 Courses

- 9.1 *The position of marks will be determined by range and bearing from a reference point.*

- 9.2 The race management team will attempt to set the longest possible first leg within the constraints of the course area and the target time. E.g. choose L2 rather than L3 or I2/O2 rather than I3/O3.
- 9.3 Where a variety of courses are provided in the Sailing Instructions it is the intention of the Race Committee to use a selection of these courses throughout the regatta.
OR Class X will sail windward/leeward courses and class Y will sail trapezoid courses.
OR Courses have been designed to cater for various conditions. The most appropriate course will be selected for the prevailing conditions at the time.
- 9.4 The course length will be laid to give the first boat of each fleet the best chance of achieving the target time.
- 9.5 For trapezoid Courses the reaching leg will be 70° interior angle for boats without spinnakers and 60° for boats with spinnakers.
- 9.6 Gates will be approximately 10 hull length wide laid square to the sailing wind. Variation in width and angle may be appropriate to adjust for current or other prevailing conditions.

10 Decisions on whether to race prior to starting

- 10.1 It is the intention of the Race Committee to:
- start races at the scheduled time if the wind conditions and visibility are within the parameters outlined in these policies;
 - not postpone to wait for better conditions; and
 - start racing even if a major wind shift is expected later unless it is visibly imminent.
- 10.2 The Race Management Team will use the following guidelines for wind strength and stability.
- Lower wind strength to start racing: A race will not be started unless there is an average of at least 4 knots for the five-minute period prior to the warning signal at the Signal Vessel (and at other places around the course where monitoring equipment allows)
 - Upper wind strength to start racing: Consideration will also be given to wave, sea conditions and peak wind speeds. If there is a strong possibility of damage to equipment, then lower wind speed conditions may trigger either of the following two situations.
 - (i) Flag D will not be raised while any race management vessel in the course area is recording five-minute averages greater than 25 knots.
 - (ii) Once the racing boats are in the racing area, a race will not be started if, in the 5 minutes prior to the warning signal, any of the committee vessels in the course area records a five-minute average greater than 25 knots. In which case, the racing boats will be sent ashore for further instructions.
- 10.3 Wind Stability: the race committee will consider not starting a race when swings measured by the signal boat are more than $\pm 30^\circ$ in the five minutes prior to the warning signal (i.e. the difference between the largest and smallest of these measurements is greater than 60°)
- 10.4 Visibility: Races will not be started if reduced visibility prevents the race management team from sighting the starting line and identifying premature starters. The fact that the first mark cannot be seen from the starting area is not a reason to postpone racing. In poor visibility consideration of safety is paramount.

11 Starting line and order of starts.

- 11.1 The starting line will generally be laid square to the median sailing wind. Current, favoured side of the course, expected wind shifts and other variables may justify variation from this guideline.
- 11.2 The starting line length will be approximately 1.5 times the number of boats times the length of the boat for most classes. For skiffs, catamarans and windsurfers the multiplying factor is 2, maybe up to 3 times in strong winds or heavy seas.
- 11.3 The starting line will be laid approximately 0.05 NM below the anticipated position of gates 4s/4p.
- 11.4 When there is no predetermined starting order in the Sailing Instructions, the proposed starting order for the first race of each day will be posted on the notice board within the terms set out in the sailing instructions for posting notices. Subsequent back to back races will be started as per section 4.5 in approximately the order in which the classes completed the previous race. Proposed starting times and starting orders may be displayed on the signal vessel accompanied by the display of Flag L as soon as they are determined by the Race Committee if it is appropriate to do so.
- 11.5 Where possible each class should be given an opportunity to be the first start of the day.

12 Starting

- 12.1 Rule 26 will be used except that Rules 30.1 and 30.2 will not be used.
- 12.2 *The starting line for large fleets (greater than 20) will be between two race committee vessels with at least two people sighting the line at each end.*
- 12.3 *Each starting line vessel will have a person writing down the boats being recorded as OCS.*
- 12.4 *Where possible video recordings will be made of the start.*
- 12.5 *Each line sighter will use a voice recorder and record, without stopping, from at least 90 seconds before the starting signal until after anything of interest after the start. The one-minute signal and the starting signal should be heard on the recording. A commentary of anything of interest should be recorded, such as boats getting close to the line, bunching, etc. The recording should include the signalling of flag P, U, or the black flag and flag X if appropriate.*
- 12.6 *Each voice recording should be labelled and not erased until after the conclusion of the entire event.*
- 12.7 *Where possible mobile telephone communication between the race officer and one pin end line sighter will be established two minutes before the start and continue until after the start while there are matters of interest about the start to be resolved.*
- 12.8 *The race officer will make the decision about whether there should be no recall, an individual recall, or a general recall.*
- 12.9 *Every effort will be made to identify as many OCS boats as possible.*
- 12.10 *When there is no telephone communication between the ends of the starting line an immediate radio communication from the pin end should be restricted to the number identified as OCS. (e.g. X boats identified)*
- 12.11 *The two people sighting the line at the port end should agree on the sail numbers of identified OCS (or UFD, BFD) and the total number considered OCS (or UFD, BFD)*
- 12.12 *Both ends of the starting line must observe and record boats returning to the pre-start side of the starting line. If all identified boats from the pin end return correctly this information should be radioed immediately to the signal boat.*

- 12.13 *Sail number information of OCS boats should be communicated to the Race Officer by mobile telephone from the pin end as soon as possible after the starting signal.*
- 12.14 Except after a Black flag general recall (when the requirements of Rule 30.4 will be met) a list of boats scored OCS will be posted on the signal boat after the fleet has rounded mark 1 for the first time or, in the case of more than one fleet on the same course, after the last fleet of that sequence of starts has rounded mark 1 for the first time. Note: write a sailing instruction to allow country codes or bow numbers when these are used as boat identification.
- 12.15 Competitors who have been scored OCS, UFD or BFD, and their coaches may listen to the voice recording(s) or view the video of the applicable start(s) at the race office.

13 Postponing A Race During the Starting Procedure

- 13.1 The race management team will postpone the race during the starting procedure if the mean wind shifts more than 10 degrees or in the event other influences cause boats to bunch at one end of the start line. In rapid oscillations the race management team will endeavour to lay a starting line based on the mean oscillations expected.
- 13.2 The race management team will consider postponing the start for any of the following reasons:
- a drifting mark,
 - a significant error in the timing of signals,
 - other boats interfering with the competing boats,
 - inappropriate starting line length or angle,
 - the positions boats are taking on the starting line indicate a line bias in the minds of the competitors,
 - a reduction in visibility preventing the race management team from sighting the starting line or identifying premature starters,
 - a change of the conditions for flag O, and
 - other factors that might affect the fairness of the race.
- 13.3 If the race management team considers that adjusting the starting line is unlikely to improve the chances of a fair start then the start will be allowed to continue.
- 13.4 For a postponement that the race management team anticipates will be longer than ten minutes, the orange starting line flag(s) will be removed (with no sound signal), and then displayed (with one sound signal) at least five minutes prior to the warning signal.

14 Individual Recall

- 14.1 *An Individual Recall will include both flag X and one sound. It will be made as soon as possible after the starting signal, but in no circumstances, should it be made later than 5 seconds after the starting signal.*
- 14.2 When, using flag P as the preparatory signal, the Race Officer is satisfied that all boats over the line have been identified, an Individual Recall (flag X with one sound) will be displayed.
- 14.3 When, using Rule 30.3 or Rule 30.4, no Individual Recall will be displayed.

15 General recalls

- 15.1 When the Race Officer is not satisfied that all boats over early (or that have broken 30.3 or 30.4) have been identified, a General Recall will be signalled.
- 15.2 If the Race Officer considers that the cause of many unidentified boats is the result of competitors being too eager, the race will be started and a general recall signalled. *This may influence a boat's score if RRS 30.4 (Black Flag Rule) applies.*

- 15.3 If a race committee error is discovered after the starting signal (e.g. timing), the race may be abandoned using the provisions of Rule 32. In these circumstances a general recall will not be signalled.
- 15.4 The race management team will not signal an individual recall and then a general recall. If the race management team considers a mistake has been made the race will be abandoned.
- 15.5 When using Rule 30.3, if a general recall would result from unidentified boats on the course side of the starting line in the minute prior to the starting signal, a postponement will be signalled immediately. If the race management team is satisfied that the starting line was fair the next start will use Rule 30.4.

16 Starting Penalties

- 16.1 The first start of each new race should normally be under flag P. Rule 30.3 may be considered for larger fleets. This should be discussed with the class concerned.
- 16.2 After a general recall which is considered the fault of the fleet, the next preparatory signal should be Black.

17 Decisions on whether to continue to race.

The Race Committee will use the following guidelines.

- 17.1 Lower wind strength.
A race will only be abandoned for lack of wind using the criteria of rule 32.1 (c). Unless the first boat is at least on the penultimate leg, a race should be abandoned, if race committee vessels at both the mark the boats are racing to and the mark they are racing from record a five-minute period with an average wind strength of less than 2 knots or if it appears that boats are drifting or most of their movement is induced by the current rather than wind power. Once the first boat has started the penultimate leg the race should not be abandoned for lack of wind. The race should either run out of time (no one finishes) or some or all the boats finish.
- 17.2 Upper wind strength.
Once started, a race will not be abandoned because of too much wind unless the race management team believes safety issues with respect to danger to life or damage to equipment are becoming a possibility now or by the time all boats (including race committee vessels) would be safely ashore. In this case, the race should be abandoned immediately.
- 17.3 Wind-shifts
In the first beat. A race will be abandoned for a shift which appears permanent if it occurs while the racing boats are in the first 50% of the first beat and a boat would lay mark 1 on one tack if they now started from any part of the starting line. However, a race will not be abandoned because of a wind-shift on the last day of the regatta if there is no longer time for a further race to start and this race is required to complete the minimum number of races for a valid series.
- 17.4 Visibility
The race management team will consider abandoning a race if it is satisfied that a reduction in visibility affects its ability to safely manage racing. The fact that boats cannot see the next mark from the prior mark is not a reason to abandon the race.

17.6 Other considerations

A race will be abandoned for unusual outside influences making the race unfair. An example would be unexpected large vessels in the racing area. Unless described elsewhere, the vagaries of the wind will not be considered a reason to abandon under rule 32.1(e).

18 Decisions on changing the course (Rule 33)

18.1 Course changes to meet the target time

Changes (other than when also changing to straighten the course) will be made to try to meet the target time only if it appears that the time for the first finisher will be $\pm 20\%$ outside the target time (i.e. less than 40 minutes or more than 60 minutes for a target time of 50 minutes). The length of a leg will be reduced to no less than 50% and increased to no more than 150% of that currently laid.

18.2 Course changes to account for a shift in the wind direction.

It is the intention of the race committee to reconfigure the course to the original configuration with respect to the direction of the wind and angle between the legs if possible and as soon as possible. Any change will minimise the change of distance fairly between fleets on the course. There may be situations when a change is not possible at all and at times for a trapezoid course only for the last leg from mark 2 to mark 3.

18.3 If it is not possible to change the course (position of the course area, resource constraints or the position of the various fleets on the course) then the race will continue to its conclusion. I.e. it will not be abandoned because of a wind-shift. (For trapezoid courses, it is highly unlikely that a course change will be made if a shift is greater than 40°)

18.4 Course changes for a wind shift will be made if possible:

- for a permanent shift of greater than 10° when the wind speed is less than 10 knots
- for a permanent shift of greater than 15° when the wind speed is greater than 10 knots

18.5 If the wind shifts prior to the fleet sailing towards the gate marks for the first time a change of course will be signalled at the preceding mark and the alternate gate marks used.

18.6 *If resources or course configuration do not give the race management team the ability to change the course using rule 33 then the following clause will be included in the sailing instructions: "Legs of the course will not be changed after the preparatory signal. This changes RRS 33."*

19 Shortening (Rule 32)

19.1 Rule 32.1 gives the conditions under which a race may be shortened. Usually races will not be shortened if it is anticipated that all boats will finish within the time limit.

19.2 When shortening the course, a blue flag will not be displayed at the finishing line.

19.3 If further races are to be sailed, a race may be shortened at a time close to the target time. The preferred option is not to shorten but to decrease the length of the legs using Rule 33, flag C and "-".

19.4 A race will not be shortened unless at least two windward legs have been sailed.

19.5 Races will not be shortened in selection trials where the event for those selected has a policy not to shorten courses. In which case the sailing instructions will include the clause: "*Courses will not be shortened. This changes RRS 32*".

20 Marks

- 20.1 Wherever possible the mark that begins a leg of a course should be left in the water while boats are on that leg.
- 20.2 The marks that make a gate will be the same size, shape and colour. *(Self-inflating marks will not be used for a gate because they are inconsistent in size when deployed)*

21 Rule 42 – Flag O ‘Off’ and Flag R ‘Restored’ for Finn, Europe, 470, 420, 29er

- 21.1 Refer to class rules and RRS Appendix P5 for information about the use of Flag O and Flag R.
- 21.2 The appropriate class rules will be used for the limiting wind speeds.
- 21.3 To avoid constantly turning off and restoring rule 42 the race committee should be certain that the increase or decrease in wind speed is expected to be above or below the limit over the whole course area that the boats are about to sail.
- 21.4 The wind speed should be consistently above or below the limiting speed before any change is implemented.
- 21.5 The jury team on the course must be informed of the intentions of the race committee to change the status of Rule 42 well before the signal is displayed.
- 21.6 Once flag O has been displayed with the warning signal, the race management team will consider a postponement if the wind becomes less than the specified limit before the start.

22 Finishing

- 22.1 The finishing line should be approximately 50m long, 75 m for skiff and catamarans, 10 boat lengths for keeler fleets, set square to the direction from the last mark.
- 22.2 The finishing line should be between staffs displaying blue flags when there are vessels at both ends of the finishing line or between a staff displaying a blue flag and the nearby finishing mark.
- 22.3 The finishing line should be laid, and the blue flag(s) displayed (no sound) before the first boat starts the final leg or the penultimate leg if there is a short reach to the finish.
- 22.4 Two independent sets of written finishing positions in complete sequential order (regardless of classes) should be taken from both ends of the finishing line. Where there are mixed fleets each boat's class should be recorded where possible. A voice recording should be made from each end of the line.
- 22.5 Where possible a video recording should be made from one end of the line.
- 22.6 A space (or spaces) should be left for boats that are obscured at the finish. Every endeavour should be made to identify these boats in a gap of finishers.
- 22.7 The time of the first and last of each class should be recorded, and if possible other times.
- 22.8 Known letter scores (DNS, OCS, UFD DNF etc) must be included on the finish sheet.
- 22.9 The blue flag(s) will be removed with no sound upon the earlier of:
 - (i) the expiration of the time limit, or
 - (ii) immediately after the last boat finishes.
- 22.10 A photograph of the hand-written results should be emailed ashore once the reconciliation of the results from each end of the line has been completed.
- 22.11 For the last race of the day the protest time limit should be transmitted to shore and be posted on the notice board.
- 22.12 It is the responsibility of the Race Officer to check that the results sent ashore match with those posted on the notice board.
- 22.13 Competitors and coaches may listen to the voice recording(s) and review the written records of the finishes.

23 Scoring

- 23.1 When a boat's score is other than her finishing position, it should be the latest or worst score. For example, a boat that is OCS and subsequently retires before finishing should be scored RET. A boat that does not finish but for some reason due to a previous infringement is scored as DNE by the jury should be scored DNE.
- 23.2 The race management team will adjust posted finishing places if it is satisfied that, based upon its records or observations, it has made a scoring error. (Rule 90.3)

24 Requests for Redress

- 24.1 If the race management team believes it may have made any other error affecting the outcome of a race for which redress may be available, it will request redress for the potentially affected boat(s).
- 24.2 The race management team will request redress for a boat if it is satisfied that the boat's score has been made significantly worse by the actions of an official vessel.

25 Race Committee protests

When considering lodging a protest the race committee should always be aware that with a race committee protest the competitor has not had the opportunity to exonerate themselves with penalty turns.

- 25.1 The race management team may protest a boat in the following circumstances when they believe:
 - (a) there has been a breach of a sailing instructions that may not be protested by another boat;
 - (b) a sailor has not sailed the course;
 - (c) a boat has failed to take a penalty after knowingly touching a mark (does not apply for windsurfers); or
 - (d) a competitor's behaviour amounts to misconduct. See RRS Rule 69

Race Committee Procedures

1 GPS Settings

General		Location	
Mode	Normal	Location format	hddd°mm.mmm'
WAAS	Disabled	Map Datum	WGS 84
Backlight Time out	15 Seconds	North Reference	Magnetic
Beeper	Key and Message	Magnetic Variation	
Language	English		
Time		Alarms	All off
Time Format	24 hour		
Time Zone	Other UTC offset +13:00 during daylight saving +12:00 otherwise		
Daylight Saving			
Current Date			
Current Time			
Units		Interface	
Elevation	Metres	Serial Data	NMEA
Depth	Metres	Baud	4800
Distance	Nautical (nm, kt, m)		
Temperature	Celsius		
Direction Display	Numeric Degrees		
Speed Filter	Auto		

Set up the Data Fields on the pointer or highway pages by:
MENU – setup page layout ENTER Medium (1 Rows) ENTER
Change data fields MENU Rocker ENTER
Highlight and ENTER
Top left BEARING
Top right DISTANCE TO NEXT
Creating Waypoints
On GPS info page (front page)
Press and hold ENTER
This gives Mark Waypoint page
It is the current position with a numeric label. Both can be changed using the
Waypoints
To Select the waypoint
MENU, MENU (gives main menu)
<ul style="list-style-type: none"> • Scroll to Points ENTER, then waypoints ENTER • Scroll to your waypoint name. • Press ENTER rocker to GO TO – ENTER - PAGE to Pointer or Highway

2 *Race Committee Vessels Call Signs and Responsibilities*

The optimum circumstance is to have one mark vessel per mark, a start pin vessel, one finish pin vessel, a finish vessel, a signal vessel, and sufficient designated safety vessels for the size and capability of the fleet.

Depending on the number of mark vessels available duties should be defined for each boat. When there is sufficient for one mark vessel per mark then responsibilities would be:

2.1 *Trapezoid Courses*

Vessel Call Sign and marks

Mark One	mark one, change mark
Mark Two	mark two, change mark
Mark Three	mark 3S and 3P, change marks
Mark Four	mark 4S and 4P, coach vessel marks below starting line
Finish Pin	finish pin, coach boat marks below mark 3 and finishing line
Finish	finish
Start Pin	start pin (port end starting line)
Signal	starboard end starting line

2.2 *Windward Leeward Courses*

Vessel call sign and marks

Mark One	mark one, 1A and change mark
Mark Four	mark 4S and 4P, coach vessel marks below starting line
Start Pin	start pin (port end starting line), finish pin
Signal	starboard end starting line, finish

For short windward leeward races where a long starting line is required a separate finish vessel should be deployed. The finish vessel should take up its position in the middle of the starting line, leaving the start pin to set up for a subsequent start.

2.3 *For All Courses*

Safety One Overall control of safety.

Safety Two, These vessels are the first response for competitor safety in the event of injury or other mishap. They should follow the fleet in accordance with the safety plan taking their direction from **Safety One**. In foul weather, all mark laying vessels would assist with safety and should be trained in facilitating the safety of both sailors and equipment.

For regattas with less boats a similar plan should be formulated.

3 *Radio Procedures*

3.1 *Call signs.*

The call sign for each mark boat relates to the mark assignment. E.g.

Mark One is "Mark One"

Mark Two is "Mark Boat Two" etc.

The **Start Pin** boat is "Start Pin".

Signal is "Signal"

Finish is "Finish"

Finish Pin is "Finish Pin"

3.2 *Procedure*

State the call sign of the vessel you are calling **first**, call this name twice, then "this is" your call sign. e.g. "*Signal, Signal this is Mark One*"

- Wait for acknowledgement prior to sending your message. If none received, repeat
- Once acknowledged, send your message, speak slowly.
- Keep the microphone out of the wind.
- Speak across the face of the microphone not directly into it.
- Take care not to have your mouth too close to the mike.
- Do not shout.
- Keep the message short and to the point.
- The channel is used by the entire team and needs to be clear - use only to give messages about the racing.
- Make sure no one else is speaking on the radio before sending a message.
- When you have been given a message, acknowledge receipt, otherwise the sender is unaware of your understanding or hearing of the message.
- Acknowledgement implies concurrence and a willingness to react to the message.
- Sign off consists of "*Mark One Out*"

Always check your radio to see that the transmit button is not turned on. Sometimes the button used to send can be "ON" due to clothing or touching another object. If you have not heard any talk on the radio for a while, check to see if:

- your mike is stuck on
- your battery is dead
- you are on the correct channel.
- the squelch is fully on

Example

Signal, Signal this is Mark One

Mark One, this is Signal go ahead

Signal this is Mark One. The wind direction is steady at 340 degrees and 5 knots. We have 0.4 knots of current from 270 degrees. Mark One over.

Mark One, this is Signal. All copied. Thank you. Signal Out.

Signal Vessel Organisation and Management

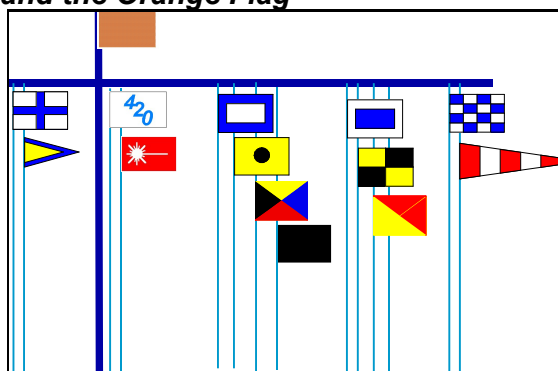
Overall philosophy

Good race management is dependent on the quality of the whole team. The Race Officer has the job of bringing together a diverse group of volunteers, ensuring that each member of the team is valued and appreciated.

The Race Officer has overall control of all race management and safety vessels on the water with responsibility for all decisions and actions needed to run the racing.

The Race Officer should have a heads-up approach, looking at the big picture to ensure the best quality race management is offered to the sailors. He or she should not be involved in the detail – that is the role played by the other volunteers. Anticipation of what might be coming and giving time to those required to carry out the tasks is a key skill. Keeping everyone informed before they are required to act, including them, and appreciating their effort is all part of the Race Officer's role.

1 Flag positions and the Orange Flag



World Sailing's recommended positions of the flags on the signal vessel.

Recommended flag size is 800mm x 600mm.

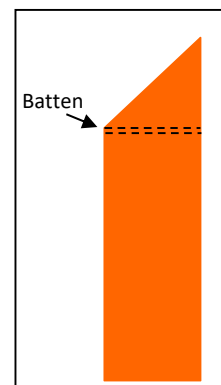
The **orange flag** is attached to the start pole and is best as a trapezoid with the bottom rectangular (see diagram). A batten at the base of the triangular part helps to ensure it is visible even in very light winds.

The following sailing instruction is World Sailing best practice.

To alert boats that a race or sequence of races will begin soon, the orange starting line flag will be displayed with one sound at least five minutes before a warning signal is made.

Lower the orange flag (no sound) when the start line is closed at the end of a sequence of starts – usually last start of the sequence plus four minutes.

It is also good practice to put the warning signal times for subsequent races on a board on the back of the signal boat at the earliest time you can. Attention to this can be made by hoisting Flag L with one sound. This is really appreciated by the sailors.



2 Personnel and duties for the Signal Vessel

Large regatta: 6 – 8 people

Race Officer, Deputy Race Officer, Timekeeper/data person, Visual Signals Officer (1 or 2), Recorder (1 or 2), Boat Skipper, (Navigator Video operator)

Club regatta: 4 people

Race Officer and 3 others (Deputy RO/timekeeper, Visual Signals Officer, Recorder)

3 Duties of the personnel on the Signal Vessel on Race Days.

This will vary based on the skills of your volunteers.

Race Officer

Radio, compass, wind pointer, voice recorder, GPS, binoculars, anemometer, range-finder, watch

Prior preparation

- Ensure all the processes and procedures have been followed in the weeks leading up to a regatta, that you are fully prepared and have contacted personnel on your course. See example email on pages 41 – 42) Do not presume it has all been done for you. This includes making sure the Notice of Race and Sailing Instructions are correct and follow the standard World Sailing structure.
- Personally ensure all the equipment for the signal vessel and all race management vessels is to the required standard and that adequate personnel are available.
- Meet key personnel prior to the regatta and if possible work with them prior to the event.
- Provide the whole race management team with a guideline of your expectations and timelines. Food, water, toilet facilities are important considerations.
- Ensure that correct radio procedure is discussed with personnel prior to the regatta.
- Think about the abilities and strengths of your team and allocate jobs accordingly.
- Do not underestimate the people management skills needed in this role – you want them to come back next day!

Race Day:

- Liaise with other ROs and shore base about the day's plans
- Attend competitor/manager briefing
- Ensure any signals ashore have been made and notices posted
- Have a copy of the marine forecast or ensure a written version of the forecast from Channel 21 (Auckland) including nowcasting is done
- After leaving the shore, complete a radio check with all race management vessels
- Monitor the breeze and record graphically. Receive data from other committee boats
- Decide on course axis and length and give directions for laying the marks
- Site the line and call OCS into a hand-held tape recorder and have the recorder writing also
- Monitor times for legs with timekeeper/data person, make decisions voice course changes, abandonment etc and implement them
- Keep contact with all committee vessels on the course and know where they are
- Call the finishes, photograph and email results ashore as soon as possible
- Decide on start times for subsequent races
- Radio to shore base the time of the last finisher of the day and get the protest time posted
- Check posted results with the originals when ashore. Sign off provisional results as final

Deputy Race Officer

Radio, compass, wind pointer, voice recorder, binoculars, anemometer, watch, clipboard

- After consultation with the Race Officer organise & check Race Management equipment for the signal vessel. Organise the personnel for Timing, Recording, and Signals
- Monitor the weather (nowcasting), measure and record breeze and tide all day – give advice to the race officer about wind speed and direction
- Assist the Race Officer with course changes
- Site the line and record OCS on a hand-held voice recorder
- Count all starters just after the start and ensure the data person records this.
- Monitor the progress of the fleet and ensure the data person is recording all the information
- Call the finishes into a hand-held voice recorder independently of RO

Navigator (if possible otherwise the DRO)

- Record the wind data from the mark vessels.
- Man the computer, analyse data, liaise with RO, enter all GPS positions of marks
- Take responsibility to ensure the integrity of the course area with regard to navigational safety
- Calculate the Reference Point position and give advice about course changes
- Video starts

Boat Skipper (may be the RO or DRO)

- Engine, fuel, berthing, anchoring where requested, water, gas, mooring lines, spare rope, tape, tools, tea, coffee, milk, food

Timekeeper, Visual and signals Officer, Recorder, Data person

- Radio, clipboard for everyone at least 3 people who are capable of doing all jobs. Timekeeper and data person may need to be one person. Check all flags are available and ready for use

Timekeeper

- Listen to the marine forecast and write it down
- GPS time check with other vessels and own crew - backup time available
- Liaise with shore base about the number of competitors who have checked out.
- Do all count downs for the start procedures over the radio including where the start is up to.
- Do time checks pre-start, during the race and finishes
- Liaise with the Visual Signals Officer just prior to any flags being hoisted
- Makes sound signals
- If no separate data person, complete the data sheets with start times, prep signal used, OCS etc including recording all wind/tide data for first and last at each mark from mark vessels. Your role is to provide the RO with a total summary of the day so he/she can report, answer questions, give information for protests against the race committee and use the data to run better races next day. Distribute and collect all forms etc.

Visual signals Officer (Maybe two people)

- Prepare, display and remove all flags and post all other signals via boards etc.
- Competitor check before the start
- Assist with mark roundings
- Recorder
- Assist with the competitor check before the start
- Write down OCS etc for RO at the start
- Record mark roundings if necessary
- Assist with all other signals, boards etc

- Record finishers and times as called by the RO – for fleet racing times are still of assistance for redress hearings although the first priority is sail numbers
- Check your results with any other recorders
- Photograph and email the results to shore.

Data person if possible (otherwise this job can be done by the timekeeper or the navigator) – needs own radio – (The recorder above cannot do this task because of the time taken with mark roundings and finishing)

- Complete the data sheets with start times, prep signal used, OCS etc, time of first and last at each mark and wind/tide data from the mark vessels. The role is to provide the Race Officer with a total summary of the day so he/she can report, answer questions, give information for protests and use the data to run better races next day.
- Distribute and collect all forms.

Example email to members of the race management team.

This communication is specific to the way we want Bravo team to operate.

We have four fleets starting at ten minute intervals so getting the course length and direction right is important as changes are always problematic. However, if we have to make changes and even shorten a race at a rounding mark we have to be prepared to do so.

Getting it right in the first place is being out there early and doing regular wind readings. We would like the Mark Vessels to take and record readings every five minutes from 1000 hours in roughly their proper position on the course. The wind recording sheet is attached. John and Todd (Mark 1) you should start a chain of transmissions every 5 minutes with wind direction and wind speed (“Signal Boat this is Mark 1 wind 230, 12knots”). You can expect a “Thank you” from the signal vessel which is the cue for Mark 2 etc. Copies of the sheet will be in your box. You are all better placed than we are to guess the best course axis and I will ask you all for that just prior to making the final decision. Wind readings should continue during the day but other things will take preference. The most crucial time will be before the second race of the day when we have the opportunity to change the entire course, so once your other duties of the first race of the day are over please begin wind measurement again in earnest.

In the usual way, we will begin our course laying by range and bearing from a reference position. The Signal Vessel will transmit to you the latitude and longitude of the middle of the mark 4 gate as the reference position. While we may give a position earlier, expect a final reference position at about 1050 hours after we have had our discussion about the wind axis. We will also give you the beat length at that time.

A copy of the tables for the specific course we are using is also attached. Mark Wooster is checking I haven't made a mistake so don't copy this version. There will be a laminated version in your box on Saturday. This course is a tweak of the standard 70 trapezoid with beat to finish. Both fleets of the laser standards are sailing the outer loop while the radials are both on the inner loop. As the standards are overall a bit quicker than the laser radials the outside beat has been extended by 15%.

Also, to enable cleaner air for those finishing, we have shortened the bottom reach to half the beat length. You can see in the diagram on the tables that this should mean those waiting to start are not so much in the way of those finishing.

With a mark vessel at each mark solely responsible for laying that mark we can leave laying the course until close to start time. As you are aware mark laying is both a science and an art. You have been chosen because you are all experienced mark layers. Therefore, we should tweak the position of the mark a little if it means the legs will be better. Marks 2 and 3 should have a discussion that Mark 2 is upwind of the mark 3 gates. It is of course, easier to move mark 2 (still keeping the reaching angle from mark 1 correct) to be directly upwind of the mark 3 gates than it is to move the mark 3 gates. So, when we lay, it is probably sensible to for us to lay mark 1 and the mark 3 gates simultaneously and then Mark 2. Mark/Colin (Mark 3) and Sean/Alessandro (Mark 2) I'm sure you can work it out between you and John/Todd you can check the mark two angle is right from your end. Gate marks should be 40 metres apart.

Similarly, it is important that the final beat from 5 to the finish is a good beat so we can lay mark 5 after laying the finish. If my calculations are correct the tables have a range and bearing for the finish vessel which puts them very slightly right of the true upwind beat from mark 5 and 185 metres (0.1NM) below the starting line. Laying mark 5 can be left until the first boats round Mark 3 for the first time (that is still have a beat and run to do before reaching to mark 5). Willie and Chris (Mark 5) your choice if you lay it early to get it out of your vessel then tweak it later or leave it until the boats round mark 3 for the first time.

Geoff and Dave (Mark 4), while it is best practice to lay the mark 4 gates after the start there is just not enough time to do so. The first beat is about eleven minutes and the run about eight so the first of the laser radials will be expected at your mark about 19 minutes after their start. The last fleet start 10 minutes later and as the biggest fleet we can expect them to take two or three minutes to clear the starting area and where you will want to lay your marks. Thus, there is not enough time to lay after the last start but you should have time to tweak it should it be

necessary – usually the best practice is to drag the windward one of the two downwind a little. The downside to laying before the start is that you will have up to 169 boats practicing exactly where you want to be! Simon, Phil, Nigel, Robert and the rest of the finish vessel team, the tables give you a range and bearing from the middle of the mark 4 gates for the position of the finish boat. I've never tried to do it this way before but once we have determined the reference position and the beat length you should be able to anchor. It isn't critical but if you can get as close as possible to that position and then anchor you will give a little more room between the finishing line and the starting line. As above Mark 5 can line themselves up to you later.

Renee/Les/Lisa/Brianna, Nigel will give you directions to lay the finish pin. The finish line length should be 50 metres but if it is rough and the finish vessel is swinging a bit on their anchor making the finish line 60 metres would probably be prudent.

Paul/Sean/Michael/Will (Start Pin) you haven't been forgotten. Starting line length is 0.17 NM (310 metres). The range and bearing from the reference point is 0.1 NM (180 metres) and add 59 degrees to the wind axis. This starting line is based on the largest fleet. We will not change between starts. We will help you get in position using our range finder. If any of you have video equipment and are happy to use it please do so. Another role for you before the start is a check off of all the boats coming to the starting area and a count up of the number of starters about a minute or so after the start.

Signal vessel you aren't forgotten either. We will organise you on practice day but to do some pre-planning our current thinking is that Linda will take care of the detail and timing while I look at the big picture, Katie 2nd line sighter and wind recorder, Ina is our technical wizard, data collector and video operator (an ipad), Richard flags and other visual signals, taking a sailors perspective and keeping track of the fleets during the race, Virginia recorder at starts and a daily log. There are a few more tasks to be allocated.

Mark roundings have an extra importance in this event because the sailing instructions enable us to give a score other than DNF for those still racing but who don't finish in the finish window. Basically, it is their relative position against other boats in the same predicament at the last mark they rounded. Therefore, we have to have good mark roundings as this could go back over several marks. We would like you all to do the best job you can with mark roundings - we know for instance that it will be almost impossible to get them all at mark 1 for the first time as they are likely to round the mark two or three deep in the middle of the fleet. We hope (as do the finish teams) that they will spread themselves out. Also at the gate marks the order can be a little problematic as some round one mark and some round the other. Mark roundings are also our way of keeping track of the fleet and accounting for everyone. Please keep us informed of first and last of each fleet (as it happens) as this will alert us if we are likely to have a problem. Mast bands are the identification key.

The sailing instructions also allow us to shorten at a mark and while I don't want to do so, if it means keeping a race - please be prepared. You will have Flag S and the four class flags in your box so you can shorten an individual fleet if necessary.

You will all have a course change board and horn to enable you to signal a course change. If we need to change the course it is mostly likely that we would signal the change at the gate and move the top marks. Sean/Alessandro (Mark 2) that means you need the coordinates of Mark 3 as we would swing your mark off Mark 3 and not the reference point for a course change. A direction change may also require a change of length to keep the reaching angle correct – for instance a left-hand shift requires 1 to 4 to be longer and 2 to 3 to be shorter. There is some seat of the pants stuff here! – that is why you are all good.

Finish team. The plan is for you to have completed results photographed and ashore within ten minutes of the last boat finishing the sequence of all four fleets – checked with finish pin too! Nigel will brief you all on the practice day. We have arranged an A3 size sheet – same as the attached rounding sheet but A3 rather than A4 - actually two A4 portrait sheets. We are yet to see a final list of sail numbers, in fact we won't until registration and measuring are complete. We will then look to see how many digits we need – hopefully only the last four and if so we will order the sail numbers by fleet and the last four digits like the example attached. For all of us, checking our list against the sail numbers is an important part of the safety plan – not only do we want to know if we have one or more missing we need to know who it is. It also means we sort out any transposition of numbers etc while it is still fresh in our memory. We have arranged an ipad to video finishes. I am concerned at the memory capacity so if any of you have other video capability and are happy to have it on board can you please bring it.

I anticipate the front of the second fleet will overtake the back of the first fleet and so on so a sequential list regardless of fleet is best. Don't try to separate the fleets. It is useful to add W, Y, G, B (the fleet colour) at the end of a number, if there is time, when it is obviously out of order.

What have I omitted that you want to know? Please ask. We are a team, it will only work if we all play our part. You are the eyes and ears of the race management team. Please let us know of anything out of the ordinary – phone is best but non-controversial things are ok over the radio. We look forward to expanding on this email at the volunteers evening next Thursday. Happy to answer questions either then or by email. If you have any equipment issues – GPS, anemometer, hand bearing compass etc can you please try and borrow or let us know soon so we can arrange for you to have them. All essential.

We are looking forward to working with you.

Cheers

John and Linda

4 Daily Schedule Example – Actual times may vary

Real Time	Time in relation to first start	Action
10:00	-3:00	Team Leaders meeting
10:30	-2.30	Meeting of all race committee personnel.
11:00	- 2:00	Check of equipment on board and that all systems function and are stowed correctly. Pick up lunches, water, radio, paper work. Safety boats launched and available to escort sailors to the race area. In normal circumstances Flag D raised. Sign on and off personnel available to sign sailors on.
11:15	-1:45	Race committee vessels leave the marina together for the race area. Radio check completed.
11:45	-1:15	Signal vessel on station anchored in the anticipated start position.
11:55	-1:05	Initial reference position determined by Race Officer and radioed to all mark boats with anticipated course axis and length (using actual wind observed by committee vessel on the way to the course area and from weather forecasts).
12:00	-1:00	All mark vessels in approximate positions starting to take wind readings.
12:00	-1:00	Initial wind speed and bearing radioed to Signal . Wind now monitored at least every 5 minutes - any significant change reported to Signal . This will be continued for the duration of racing. Use GPS to estimate current flow. Complete time check with timekeeper.
12:30	-0:30	Wind speed and direction updated to Signal .
12:50	-0:15	Finish, Finish Pin and Mark Four move out of the course area to their approximate positions. Start Pin moves to anchor. Final adjustments of Starting line made before the preparatory signal. Signal determines the final reference position and transmits it to all boats. Mark Four adjust the coach vessel mark below Signal and lays the coach vessel mark below Start Pin.
12:55	-0:10	Course axis and length confirmed by Race Officer. Mark vessels move into final position to lay marks. Display orange flag with one sound.
1300	-0:05	Warning signal, one sound. Last adjustments to starting line.
1301	-0.04	Preparatory signal, one sound. Mark 1 laid by this time.
1304	-0.01	Remove preparatory signal with long sound.
1305	0:00	Starting signal of first class to start, one sound. Mark 2 laid by this time.
	+0:10	Mark 3 Gates laid.
During the race		Mark vessels continue to record wind speed and direction at least every 5 minutes and monitor the position of the mark, report significant wind changes to Signal and any movement of the mark. Measure tidal flow every 15 minutes when possible Record every boat (sail number and time) as they round the mark every time. Report to Signal the time of first and last round the mark as they round the mark.
Course change (signalling)		On instruction of Race Officer move to correct position to signal a course change. Deploy correct signals and sounds when the course change is confirmed by Race Officer.
Course change (moving the mark)		Move to a new position as indicated by range and bearing from Race Officer and deploy mark if required. Remove old mark as soon as possible.
End of Racing		Retrieve all marks.
Back at the dock		Refuel, tidy up, stow all gear and report any damage or lost gear to equipment officer. Return all paper work to Signal. Return radio for charging.
Race end + 60 min		Team de-briefing.

Race Officer Information for Course Laying

1 Courses

The course tables at the back of this book cater for a variety of course configuration. These tables can be used when there is **one** or a number of mark laying vessels. For novice mark layers the race officer may choose to give the mark layer only the reference point latitude and longitude (numerically or by “pinging”) and the range and bearing of each mark in turn to enable the mark layer to concentrate on just that mark. For experienced mark layers, the race officer should just tell the mark layer the reference point latitude and longitude, the course axis and length of the first beat. In this case mark layers need to be familiar with the tables and what they contain prior to going afloat.

As the beat length increases, the shape of the course remains the same with other legs increasing in the same proportion, apart from the distance from the start to the mark 4 gate and from mark 3 to the finish. The tables should be used with common sense. The size of the course will depend on wind speed, the type of boats and the number of laps to be sailed. Course laying is an art and a science. Once a mark vessel is in the position given using the tables, checks should be made and adjustments carried out to ensure marks are laid to achieve the objective of fair courses. Legs should be set to be as true to the wind direction experienced by the racing boats as possible. The angle for reaches should be consistent with that required by the classes concerned.

- Set the course length to give the first boat the best chance of completing the course close to the target time. (See VMG Data)
- When possible lay Marks 4S/4P, the gate downwind of Mark 1 (or Mark 1A), after the start.

1.1 Trapezoid Courses

- For windsurfers and boats without spinnakers set a reaching leg 110° off the wind.
- For boats with spinnakers set a reaching leg 120° off the wind
- Using the reaching leg of half the beat length keeps fleets closer together and is easier to set where the start/finish line is the same and means the outer loop is not too short. Having a reaching leg of two thirds the beat length gives more separation between fleets and is useful in very big multiple start fleets.

1.2 Windward/leeward courses

- The middle of the starting line and middle of the gate marks should be set downwind of Mark 1A
- An offset mark (Mark 1A) laid 80° off the wind and a distance of 0.03 nm (60 m) from mark 1 is usually satisfactory.

2 The Reference Point.

When using a GPS and these tables to assist with mark laying each mark is defined by the range and bearing from a single point. This allows the initial position of each mark to be found independently of any other. The final position of the mark should be adjusted to account for the actual wind conditions in that part of the course.

For want of a better name this single point is call the **Reference Point**. There is nothing unique or special about this point, however, some points are more convenient than others. Once the beat length is close to 1 nautical mile or more any of the first three reference points described below will allow a good course to be laid using the tables. The tables have been calculated using the middle of the mark 4 gate. Total course distances have been calculated using this reference point.

One advantage of mark layers familiar with entering the reference point by latitude and longitude, is there is no need for some mark layers to ever need to be in the starting area therefore minimising the time required. It may decrease the amount of fuel used and allows mark layers time to do other tasks like measuring the wind. Also when there is more than one mark layer, competence in sharing coordinates of the positions of marks allows a course to be swung from any mark for course changes.

2.1 Reference Point is the middle of the mark 4 Gate (or Mark 3 of a Triangular course)

Pros

- (a) Mark 1 directly upwind of middle of the starting line and mark 4 for accurate inner loop beats.
- (b) Lengths of other legs are proportional to the distance from the reference point to mark 1.
- (c) The reference point is the “turning point” for the inner loop for course changes.
- (d) The tables are set up using this point.

Cons

- (a) Depends on the relationship between the starting line length and the distance above the starting line of Mark 4 gate.
- (b) Requires use of the “Project Location” or similar to determine the latitude and longitude
- (c) Is an imaginary point – nothing gets laid there. Its position needs to be given to other mark vessels by a latitude and longitude.

2.2 Reference Point is the middle of the starting line

Pros

- (a) Mark 1 directly up wind of the middle of the starting line for accurate first beat.
- (b) Only dependent on the starting line length.

Cons

- (a) Inner and outer loops different lengths.
- (b) Requires use of the “Project Location” or similar to determine the latitude and longitude
- (c) Is an imaginary point – nothing gets laid there. Its position needs to be given to other mark vessels by a latitude and longitude.

2.3 Reference Point is the location of the signal vessel

Pros

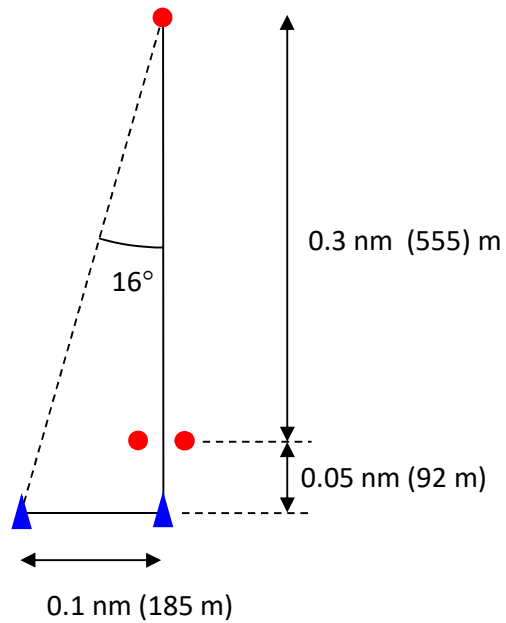
- (a) Easy to calculate as it is the signal vessel’s location, thus the signal boat GPS has this information at all times without calculation.
- (b) An actual identified point which can be “pinged” by a mark vessel thus preventing the need to transmit the information.
- (c) A point which can be seen from other parts of the course as it is the signal vessel.
- (d) If the gate is placed directly upwind of the signal vessel, the signal vessel can signal a change of course.

Cons

- (a) For long starting lines and short courses the pin end of the starting line is skewed.

Example:

First beat 0.35 nm (650 m)
Starting line length 0.1 nm (185 m)
If the signal is directly downwind of mark 1 the pin end is skewed by 16°



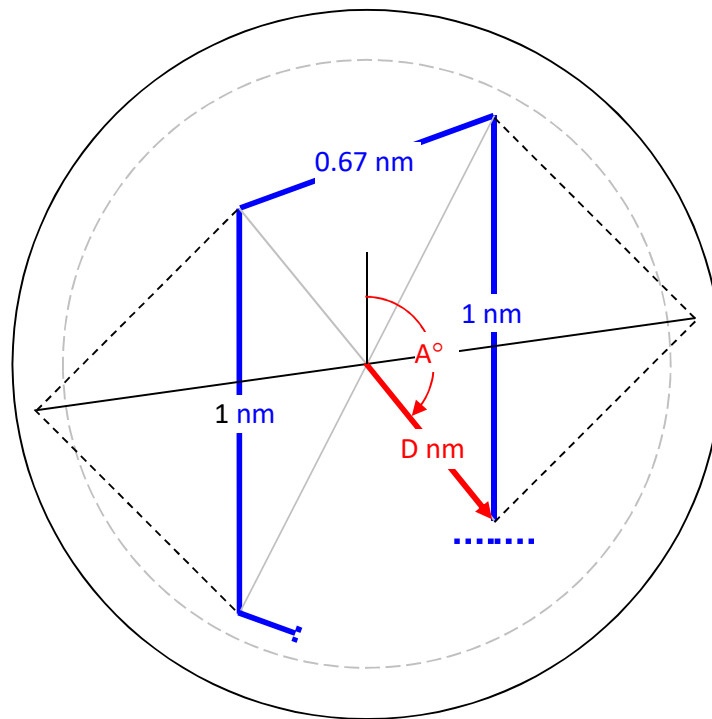
(b) Inner and outer loops will be different lengths.

2.4 Reference Point is the centre of the course area circle.

Pros (a) Ensures the course is as close as possible to the centre of a designated circle.

(b) Useful as an initial reference point for the signal vessel.

Cons (a) Difficult to relate other marks to the wind direction.

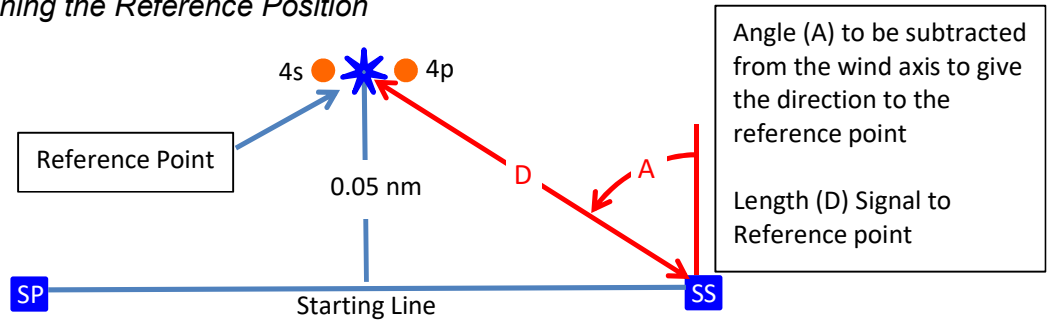


70° (60°) Equal beats Trapezoid with reaching leg two thirds the beat length

For 1 nm beat the circle diameter is 1.5 NM (1.6NM) for a 0.05 (90 m) room around marks 1 and 3, or 1.75 NM (1.7 NM) circle diameter for a 0.05 NM clearance around the extremities of the 4-1 and 3-2 laylines.

The reference point (Mark 4) should be set at wind direction plus 141° (139°) and a distance 0.5 (0.44) times the beat length from the centre of the circle if the course is to be centred on the course area circle.

2.5 Determining the Reference Position



See the last page of this book for a table of A and D for start line length from 80 to 500 m

2.6 Finding the Reference Position using the Garmin 76

This is most likely a task for the Navigator or Deputy Race Officer on board the Signal Boat.

Before going to sea create a waypoint named “REFERENCE”

Determine the Start line length (see next page), and then use the table above to find:

- the angle (A) to be subtracted from the course axis; and
- the distance (D) from the Signal Vessel to the reference point.

When the course axis is determined by the Race Officer, subtract angle A from the course axis. This is the bearing from the Signal vessel to the reference position.

On the GPS:

MENU MENU

Scroll to Points ENTER

Scroll to Waypoints ENTER

Scroll to REFERENCE ENTER ENTER

You should now have the screen headed up Waypoint REFERENCE

MENU

Scroll to Project Location ENTER

Scroll up to Distance ENTER

Input the correct distance using the rocker bar ENTER

Scroll down to Bearing

Input the correct angle (Course axis minus A) using the rocker bar ENTER

Scroll down to Save ENTER

This screen gives the correct Latitude and Longitude of the reference point. It can now be transmitted to the Mark vessels.

3 Starting line

- 3.1 The starting line will be set square to the mean sailing wind direction as measured on a drifting boat.
- 3.2 The starting line will be set 0.05 nm below the 4S/4P gate mark.
- 3.3 The table below is a guide to the length of the starting line for different classes.

Class	Boat Length	Multiplying factor	Number of Boats	Start Line Length Metres
29er	4.4	2	20	180
420	4.2	1.5	20	130
470	4.7	1.5	20	140
49er / 49er FX	4.9	2	20	200
Finn	4.54	1.5	20	140
Laser / Radial	4.24	1.5	20	130
Nacra 17	5.25+	2	20	210
OK	4.00	1.5	20	120
Optimist	2.36	1.5	20	70
P Class	2.134	1.6	20	70
RS:X	2.86	3	20	170
Splash	3.55	1.5	20	100
Starling	2.91	1.5	20	90
Zephyr	3.6	1.5	20	110

In strong current and higher winds and waves these lengths may need to be increased. When two or more fleets are using the same starting line it may be better to compromise these lengths to leave the starting line alone rather than delay starts to reset the line at the optimum length. For short starting lines consideration needs to be made for the effect race committee vessels have at the ends of the starting line.

4 Gate Marks

- 4.1 Gates should be set square to the mean sailing wind measured on a drifting vessel.
- 4.2 The distance between gate marks should be as set out in the table below

Class	Boat Length (metres)	Multiplying Factor	Distance (metres)
29er	4.4	10	50
420	4.2	10	40
470	4.7	10	50
49er / 49er FX	4.9	10	50
Finn	4.54	10	50
Laser / Radial	4.24	10	40
Nacra 17	5.25+	10	60
OK	4.00	10	40
Optimist	2.36	13	30
P Class	2.134	14	30
RS:X	2.86	14	40
Splash	3.55	10	35
Starling	2.91	10	30
Zephyr	3.6	10	35

5 Finishing line

- 5.1 The finishing line should be approximately 50 m long (75 m for skiff and catamarans) in length, set square to the direction from the last mark.

Mark Vessel Duties and Procedures

- 1 While these procedures have been written primarily for a trapezoid course, the principles are the same regardless of the course configuration.
 - 1.1 Mark vessels shall be crewed by at least two people.
 - 1.2 GPS shall be set on nautical miles (decimals), magnetic bearings, and WGS 84 Map datum. (See page 28 - Using the GPS). All times will be derived from GPS time.
 - 1.3 The position of all marks will be determined by range and bearing from a reference point.
 - 1.4 An initial reference point and an anticipated course axis and length will be determined by the Race Officer by at least start minus 65 minutes. A final reference point will be broadcast by start minus 15 minutes.
 - 1.5 Mark vessels will be on station in approximate mark position at start minus 60 minutes and have taken first wind reading by this time.
 - 1.6 The Mark vessel laying the windward mark should lay a temporary mark in the approximate position of this mark so that tide readings can be made. **Start Pin** will take tide readings from the coach boat zone mark laid below the **Signal**.
 - 1.7 Tide readings will be made every 15 minutes once marks are laid (being mindful of keeping out of the way of the racing fleets).
 - 1.8 The final course axis and length will be determined by start minus 10 minutes. At this time Start Pin will be anchored and **Mark Four** will lay or adjust the coach boat marks below the starting line. Mark 1 will be laid by the preparatory signal, Mark 2 by the starting signal, Mark 3 before the first of the first fleet rounds Mark 1, Mark 4 as soon as possible after the start of the last of a sequence of starts. (Best practice to lay 4s/4p after the start but sometimes this is not possible and the need to be laid before the first of the sequence of starts) Finish and Finish Pin should be laid before the first racing boats round the penultimate mark for the last time. Finish Pin will lay the coach boat marks below the finish before anchoring.
 - 1.9 Mark 3 gates should be directly downwind of Mark 2 (using wind adjusted for the effect of current). If the angle is greater than $\pm 5^\circ$ degrees different than that signalled on the Signal vessel as the course axis then a change of direction should be signalled at Mark 2.
 - 1.10 Once marks are laid the Latitude and Longitude of each mark will be recorded and radioed to the **Signal**. Mark vessels will also record this information so that range and bearing from any mark may be used for course changes. In particular Mark 1 and 4 will share their positions and likewise Mark 2 and 3.
 - 1.11 During the race wind speed and direction will be monitored every 5 minutes and current measured every 15 minutes. Any change of 10° or more which appears permanent will be transmitted to the **Signal**.
 - 1.12 Mark roundings will be recorded by mark vessels and the times of first and last of each fleet radioed to the **Signal** as each happens.

2 Mark vessel positions in the period start minus 60 to start minus 45 minutes.

- 2.1 Race Officer estimates the course axis and length and determines the mark laying reference position so that boats may take up positions to monitor the wind and tidal flow prior to the course being laid. The aim is to monitor wind speed and direction in as many parts of the course as possible. Regular relaying of this information is vital for the Race Officer to choose a suitable wind axis. It is essential that wind direction is monitored by drifting boats as this is the wind experienced by the racing boats.
- 2.2 Signal anchors in its anticipated position. **All other vessels remain drifting.** Every vessel monitors wind speed and direction every 5 minutes and monitors drift using the features of the GPS. Once a mark is laid, tidal flow is monitored using a tide stick.

Signal at starboard end of the starting line.

Start Pin on the mark laying reference position.

Mark One at the expected position of mark 1

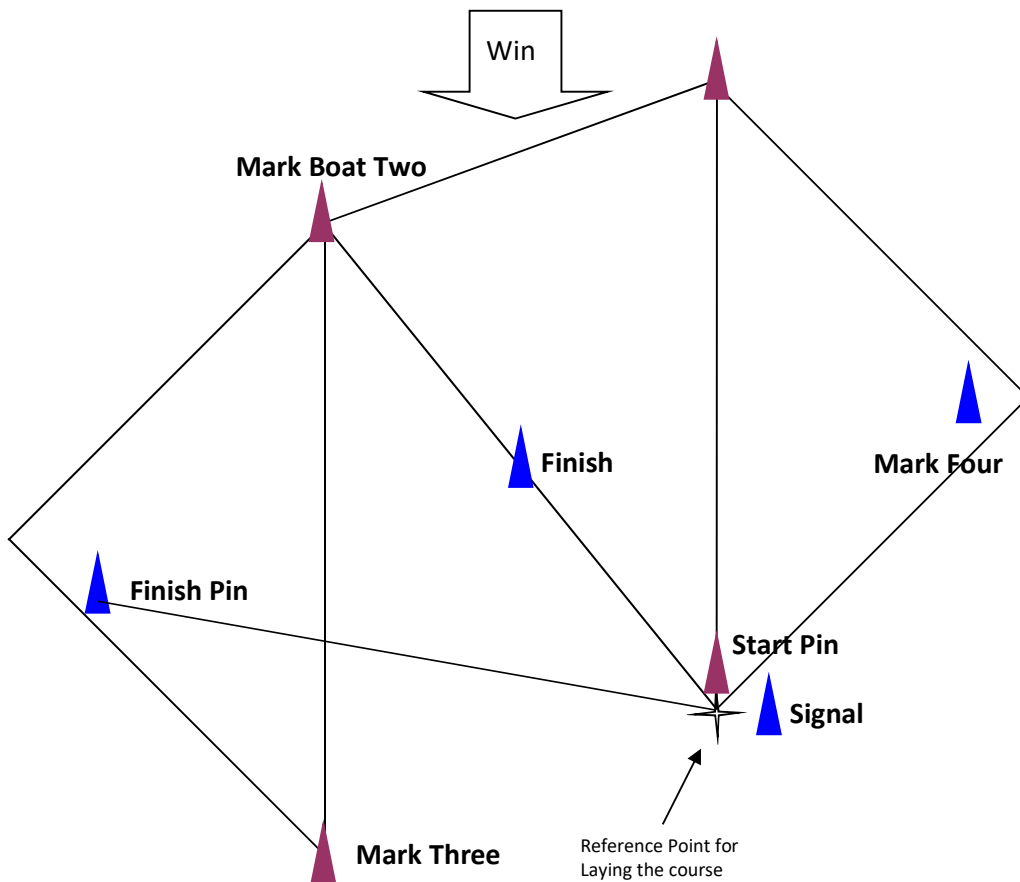
Mark Two at the expected position of mark 2

Mark Boat Three at the expected position of mark 3S/3P

Mark Four at position 0.7 times expected first beat length at a bearing of wind axis plus 40°

Finish at a position half the length and on the bearing of mark 2 from Start

Finish Pin at a position the length of the expected first beat length at a bearing of wind axis minus 80°



Position of Race Committee vessels before laying the Course for windward-leeward courses

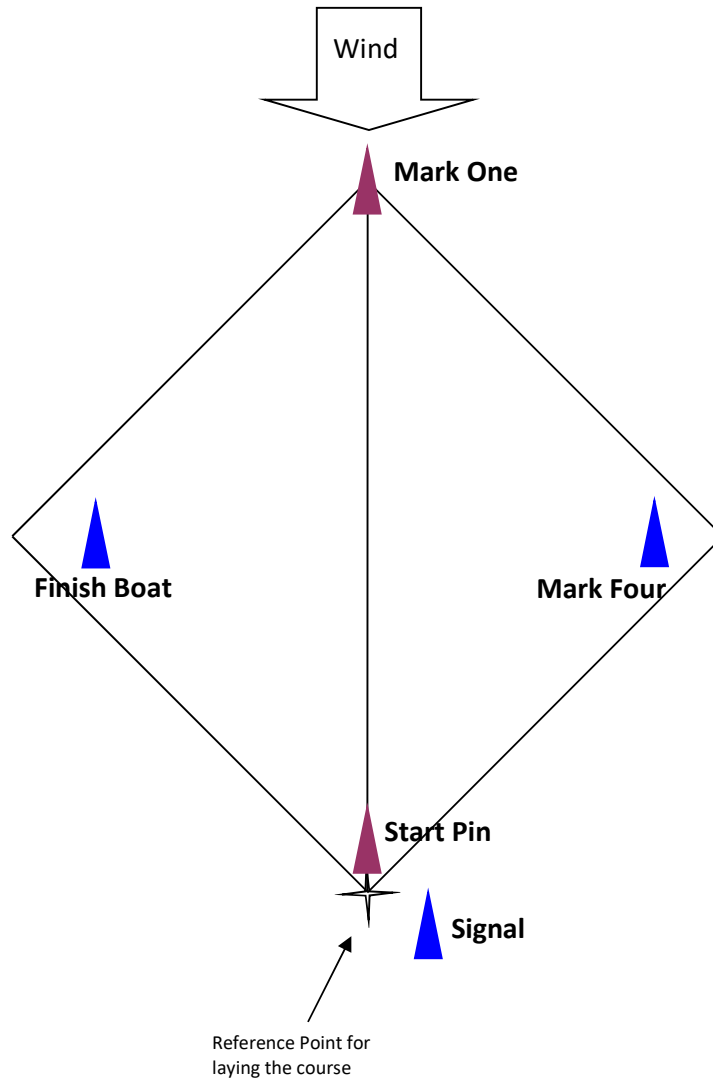
Signal at starboard end of the starting line.

Start Pin on the mark laying reference position.

Mark One at the expected position of mark 1

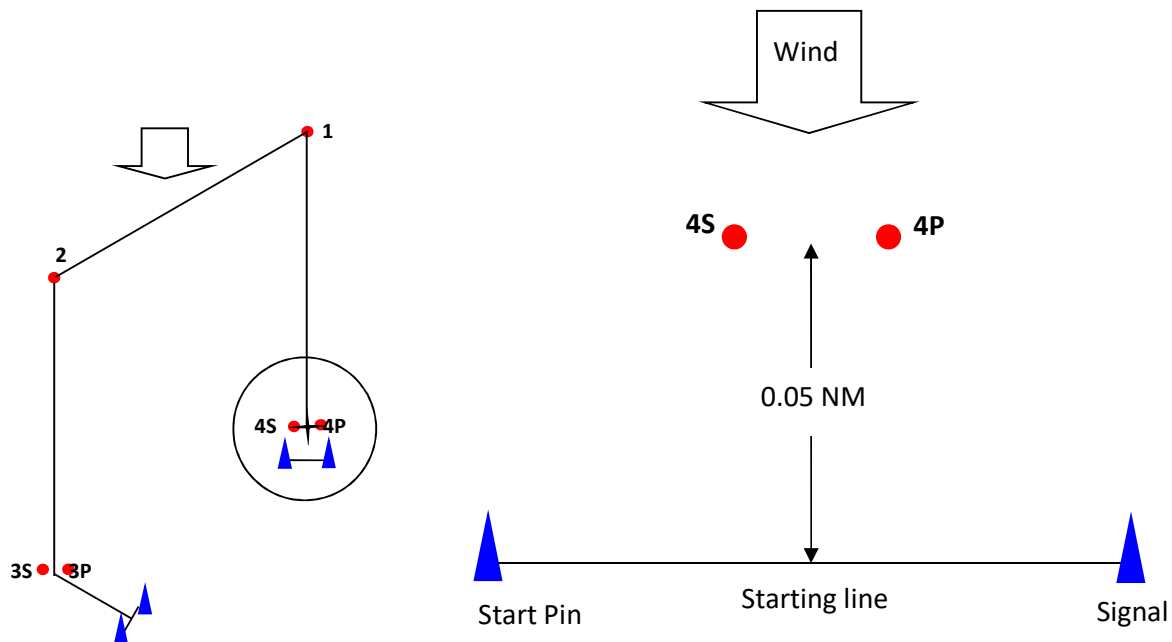
Mark Four at position 0.7 times expected first beat length at a bearing of wind axis plus 40° (Bearing to reference = wind axis minus 140°)

Finish at position 0.7 times expected first beat length at a bearing of wind axis minus 40° (Bearing to reference – wind axis plus 140°)



3 Laying the start pin

- 3.1 Ping the signal vessel. The starting line length will be given by the RO.
- 3.2 Proceed out at about 100 degrees on the port side of the signal boat to the desired distance. Use GPS and Laser Range Finder to help determine this distance.
- 3.3 Turn to move slowly directly into the wind and under direction of RO, note the position that he advises is the desired location of the pin.
- 3.4 Take a compass heading to Signal from this spot and continue to weather.
- 3.5 Go to weather to gain enough distance to:
 - get a good set, and the proper rode/scope minimum of four times the depth of water
 - add enough rode so you can move up 5 degrees if requested (10 m for every 100 m of starting line length)
 - have enough rode to move back 5 degrees
- 3.6 After anchoring move back to compass position.
- 3.7 Check location using a compass.
- 3.8 Continue to monitor position with a compass.



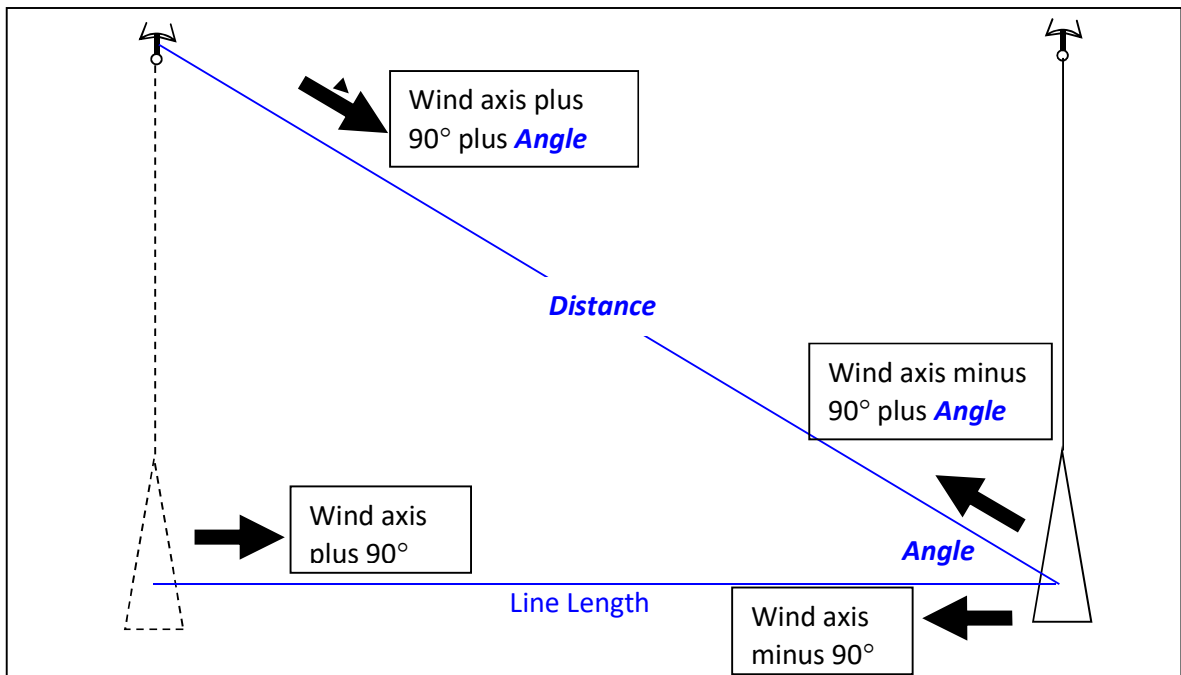
4 Laying a start pin buoy

- 4.1 The vessel laying the buoy should begin well below the starting line and stream the buoy by retaining only the anchor in the vessel.
- 4.2 Motor forward, towing the mark, at the same angle as the set of the anchor rode of a boat anchored only by the bow (see page 48 Laying the Gate Marks).
- 4.3 Use GPS or Rangefinder to help obtain the desired distance from Signal.
- 4.4 Watch for hand signals and/or listen for the instruction to drop the anchor.

5 Laying the Start Pin vessel for a starting line square to the breeze - no current
 Based on 4:1 anchor rode line and distances in **metres**. Use the tables to find the "Angle" and "Distance" defined in the diagram below for a given starting line length and depth of water.

Angle		Line Length (metres)																	
		30	40	50	60	70	80	90	100	120	140	160	180	200	220	240	260	280	300
Depth (metres)	5	30	24	19	16	14	12	11	10	8	7	6	6	5	5	4	4	4	3
	10	49	41	35	30	27	24	21	19	16	14	12	11	10	9	8	8	7	7
	15	60	53	46	41	37	33	30	28	24	21	18	16	15	13	12	11	11	10
	20	67	60	54	49	45	41	38	35	30	27	24	21	19	18	16	15	14	13
	25	71	65	60	56	51	48	44	41	36	32	29	26	24	22	20	19	17	16
	30	74	69	65	60	56	53	49	46	41	37	33	30	28	26	24	22	21	19
	35	76	72	68	64	60	57	54	51	46	41	37	34	31	29	27	25	24	22
	40	78	74	70	67	63	60	57	54	49	45	41	38	35	32	30	28	27	25
	45	79	76	72	69	66	63	60	58	53	48	45	41	38	36	33	31	29	28
	50	80	77	74	71	68	65	63	60	56	51	48	44	41	39	36	34	32	30

Distance		Line Length (metres)																	
		30	40	50	60	70	80	90	100	120	140	160	180	200	220	240	260	280	300
Depth (metres)	5	35	44	53	63	72	82	92	102	121	141	161	181	201	221	241	261	281	301
	10	46	53	61	69	78	87	97	106	125	144	164	183	203	223	243	262	282	302
	15	60	66	73	80	88	96	104	113	131	150	168	188	207	226	246	265	285	305
	20	76	81	86	92	99	106	114	122	139	157	175	193	212	231	250	269	289	308
	25	93	96	101	106	112	119	126	133	149	165	182	200	218	237	255	274	293	313
	30	109	112	116	121	126	132	138	145	159	175	191	208	226	244	262	280	299	318
	35	126	129	132	136	141	146	152	158	171	186	202	218	235	252	269	287	306	324
	40	143	146	149	152	157	161	166	172	184	198	213	228	244	261	278	295	313	331
	45	160	163	165	169	172	177	181	187	198	211	225	239	255	271	287	304	321	339
	50	178	180	182	185	188	192	197	202	212	224	237	251	266	281	297	313	330	347

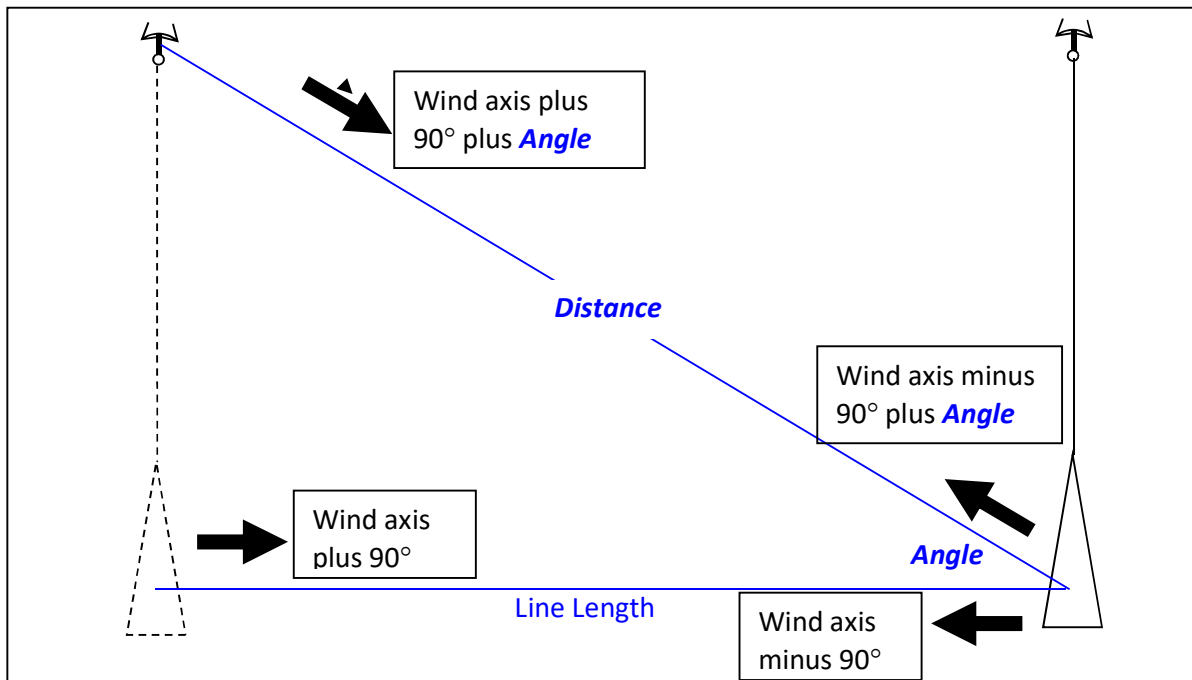


Example: For a line length of **240 metres** in **25 metres** of water, the pin vessel should place the anchor at an **Angle 20°** further upwind of the final position at a **Distance of 255 metres** from the anchored signal vessel.

6 Laying the Start Pin Boat for a starting line square to the breeze - no current
 Based on 4:1 anchor rode line and distances in **nautical miles**. Use the tables to find the “Angle” and “Distance” defined in the diagram below for a given starting line length and depth of water.

Angle		Line Length (nautical miles)																		
		0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
Depth (metres)	5	25	17	13	10	9	7	7	6	5	5	4	4	4	4	3	3	3	3	3
	10	43	31	25	20	17	15	13	12	10	9	9	8	7	7	7	6	6	6	5
	15	54	43	35	29	25	21	19	17	15	14	13	12	11	10	10	9	9	8	8
	20	61	51	43	36	31	28	25	22	20	18	17	16	15	14	13	12	12	11	10
	25	66	57	49	43	37	33	30	27	25	23	21	19	18	17	16	15	14	14	13
	30	70	61	54	48	43	38	35	31	29	27	25	23	21	20	19	18	17	16	15
	35	73	65	58	52	47	43	39	36	33	30	28	26	25	23	22	21	20	19	18
	40	75	68	61	56	51	46	43	39	36	34	31	29	28	26	25	23	22	21	20
	45	76	70	64	59	54	50	46	43	40	37	35	32	31	29	27	26	25	23	22
	50	78	72	66	61	57	53	49	46	43	40	37	35	33	31	30	28	27	26	25

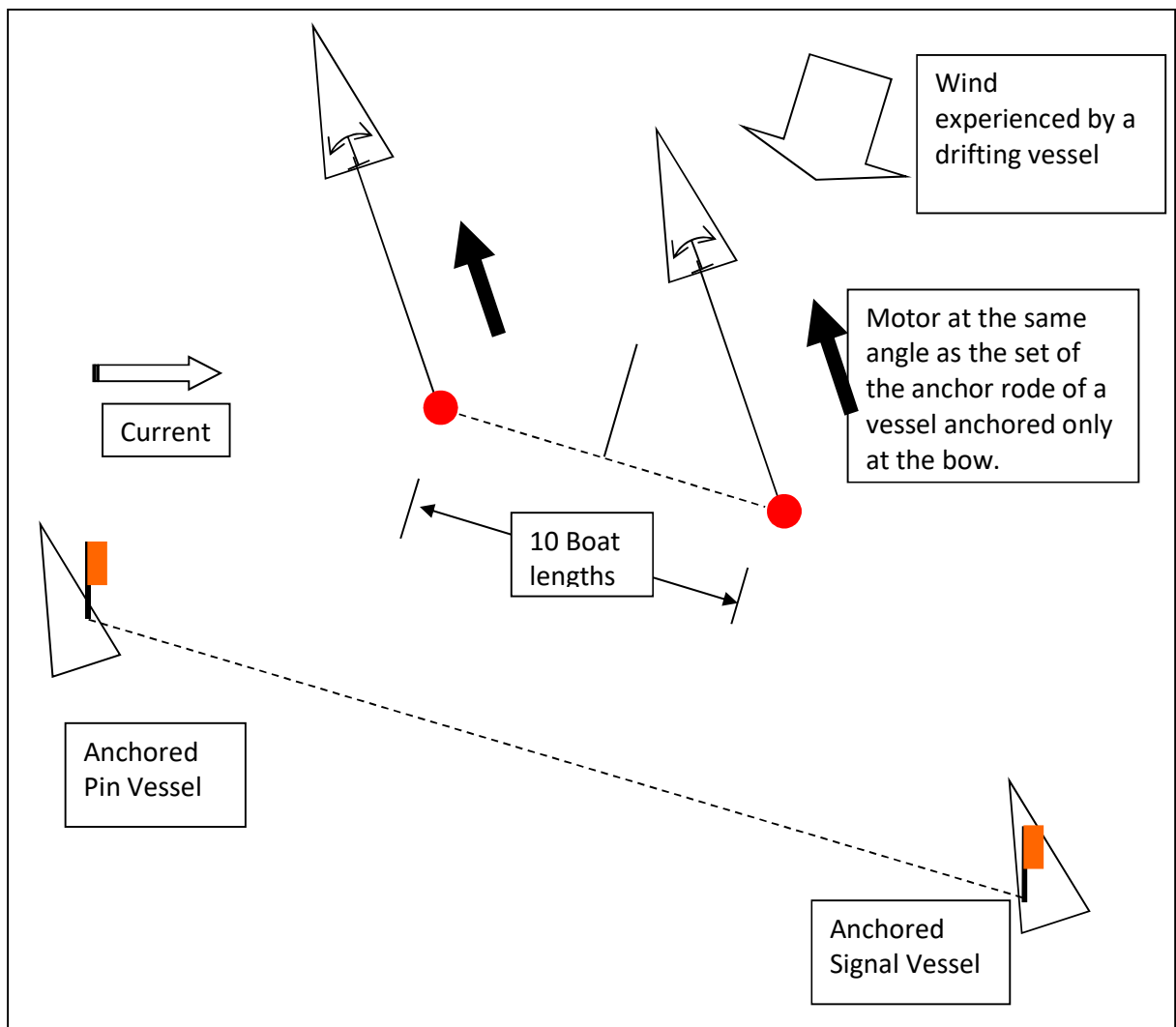
Distance		Line Length (nautical miles)																		
		0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
Depth (metres)	5	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
	10	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
	15	0.03	0.04	0.05	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
	20	0.04	0.05	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.19	0.20
	25	0.05	0.05	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21
	30	0.06	0.06	0.07	0.07	0.08	0.09	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21
	35	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.12	0.13	0.14	0.15	0.15	0.16	0.17	0.18	0.19	0.20	0.21
	40	0.08	0.08	0.08	0.09	0.09	0.10	0.11	0.12	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.19	0.20	0.21
	45	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22
	50	0.09	0.10	0.10	0.10	0.11	0.12	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.18	0.19	0.20	0.21	0.22



Example: For a line length of 0.13 nm in 25 metres of water, the pin vessel should place the anchor at an **Angle** 19° further upwind of the final position at a **Distance** of 0.14 nm from the anchored signal vessel.

7 Laying the Gate Marks using two vessels

- 7.1 Both vessels move together from behind the starting line (or below the position of Mark 3) and stream the mark and all the chain/rode trailing behind with only the anchor in each boat.
- 7.2 The vessels should cross the starting line together to keep the bearing between the vessels as wind axis plus or minus ninety degrees. The distance between the vessels is estimated to be the correct distance between the gate marks.
- 7.3 On direction of the RO, drop both anchors simultaneously.
- 7.4 When there is significant current the vessels should motor in a direction that the anchor rode of the marks will be when finally anchored – watch the way in which a vessel anchored only by the bow is lying relative to its anchor.
- 7.5 An imaginary line between the two marks should be at right angles to the wind direction experienced by a drifting vessel.
- 7.6 Adjust as required:
 - by dragging the windward one of the two marks downwind.
 - by adding extra warp to the windward one of the two marks.



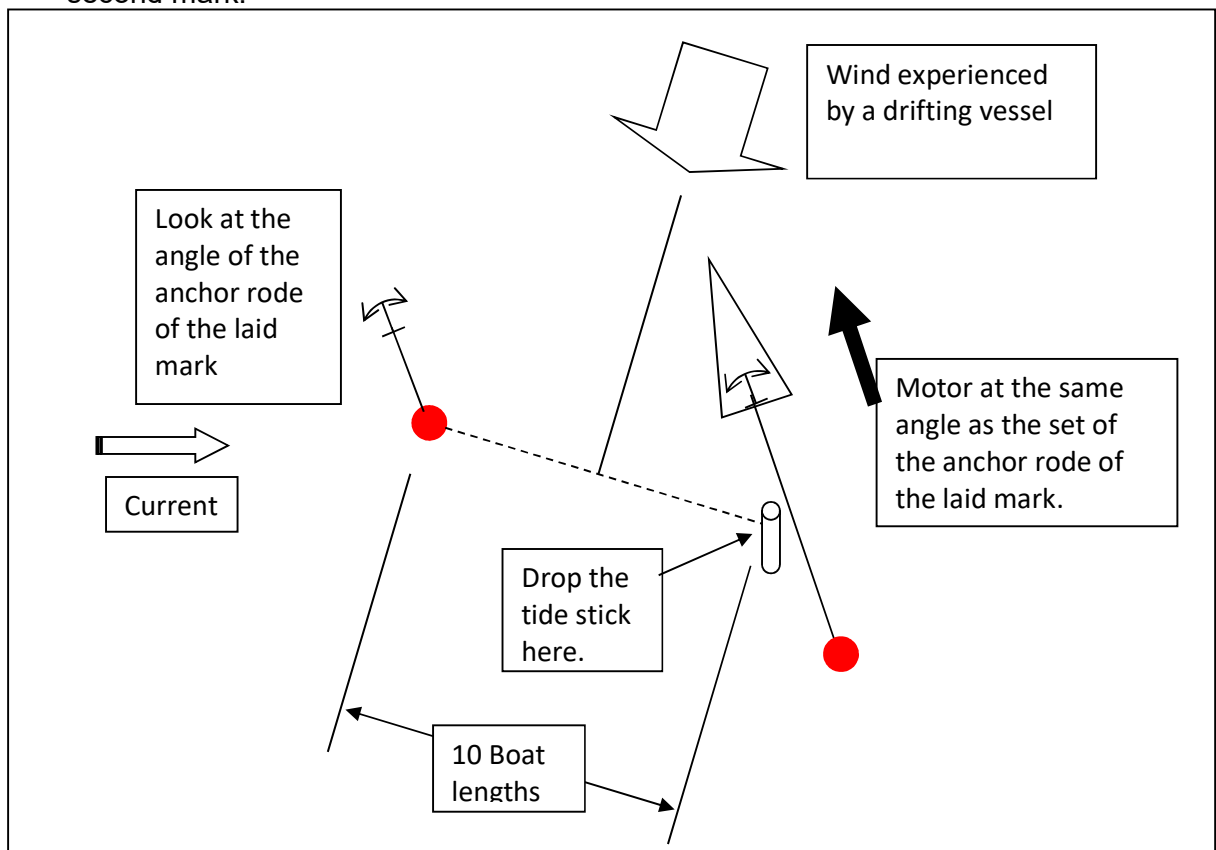
7 Laying the Gate Marks using only one vessel

MINOR TO NO CURRENT

- 8.1 When instructed to lay the gate, go to the Mark 3 position by range and bearing from the reference position to lay 3S/3P (or to the reference position to lay 4S/4P).
- 8.2 Look up the course to check that this is downwind of mark 2 (or mark 1) and adjust if it is not.
- 8.3 Motor to port (looking up the course) a couple of vessel lengths and lay mark 3S by lowering the anchor while keeping some weight on the warp. (This is the left hand mark as you look up the course).
- 8.4 Check that the mark is sitting upright and that the anchor is holding.
- 8.5 Return downwind of this mark and this time trail the mark and the warp with just the anchor aboard the mark vessel.
- 8.6 Motoring slowly to weather, pass mark 3S on your port side an estimated distance of around 7 boat lengths (30 meters) (8 boat lengths if high wind).
- 8.7 When the compass bearing of mark 3S is "wind axis minus 90°", drop your tide stick in the water to mark the location you wish the mark to come to rest.
- 8.8 Continue motoring until the mark you are towing gets to about 3 m downwind of the tide stick, drop the anchor.
- The marks should be at right angles, relative to the wind as measured by a drifting boat.
- 8.9 For small adjustments drag the windward mark downwind.
- 8.10 For large adjustments pick up one mark and relay.

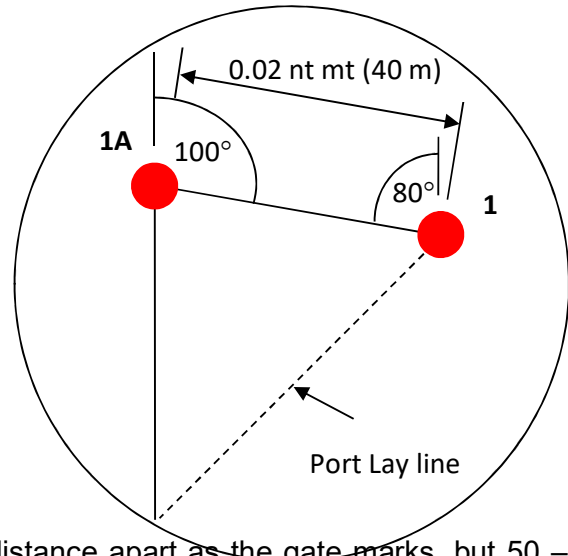
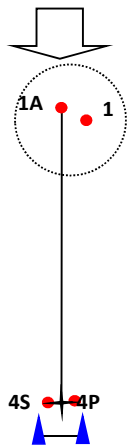
STRONG CURRENT

- 8.11 Follow the above procedure. Before returning downwind, observe the angle of the anchor rode of mark 3S. It is this direction that you should motor when towing the second mark.



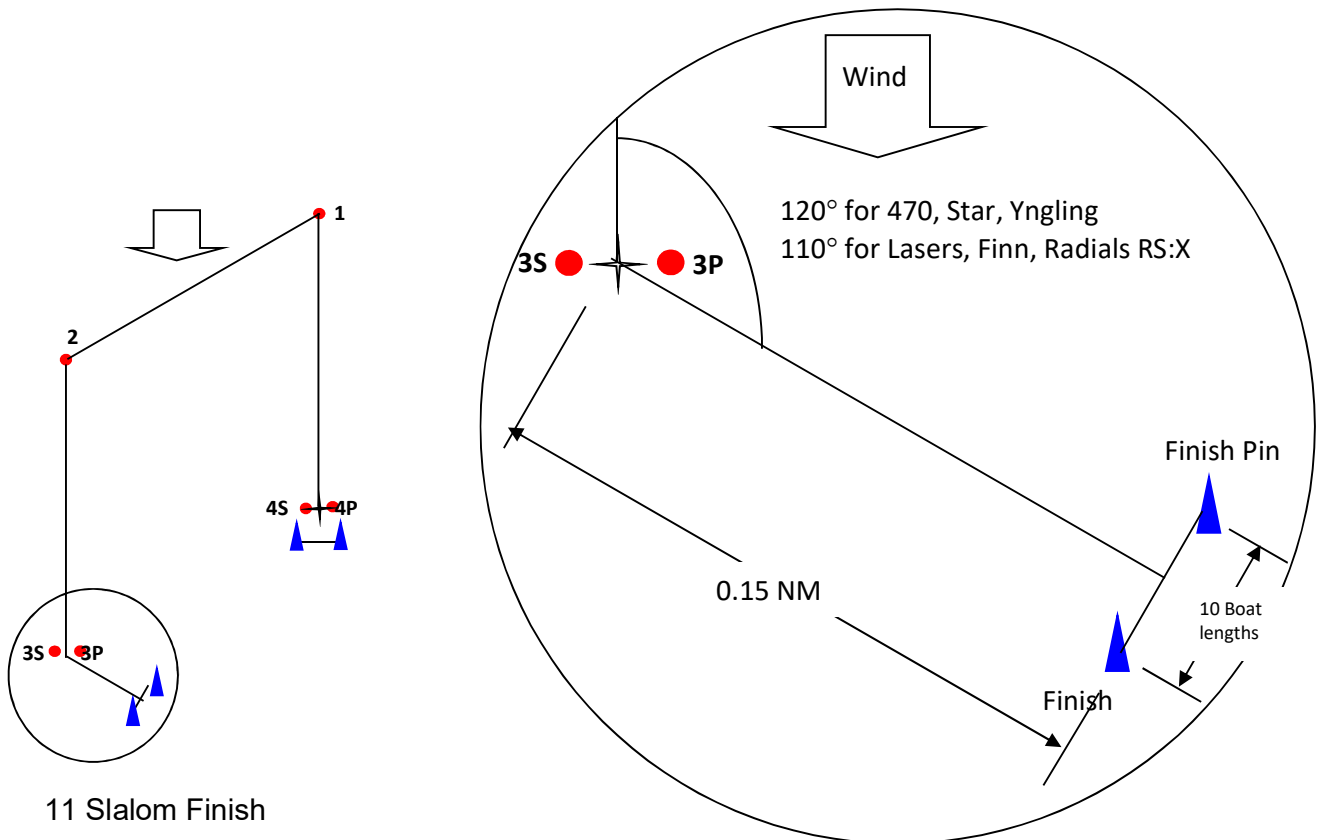
9 Laying Mark 1 and an Offset mark

- 9.1 Lay the offset mark first using the range and bearing from the Reference Point.
- 9.2 Ping this offset mark with GPS and proceed to starboard at plus 90° to the course axis for approx 0.02 NM (40 meters), use a rangefinder if available to help determine this distance.
- 9.3 Read back the reciprocal heading.
- 9.4 If the wind has a tendency to go right set the mark at course axis plus 100°
- 9.5 If the wind has a tendency to go left set the mark at course axis plus 90°
- 9.6 To anchor, move the mark vessel to weather to achieve the objective with appropriate Rode/scope.

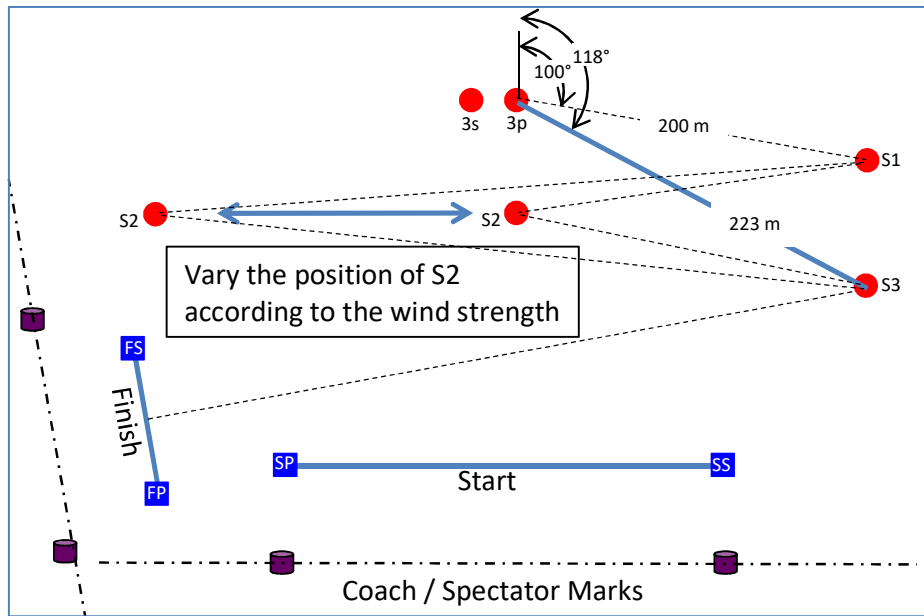


10 Laying the Finishing Line

- 10.1 The finishing marks should be the same distance apart as the gate marks, but 50 – 60 meters is usually good.
- 10.2 Set the finishing line at right angles to the direction of the course from the last mark.
- 10.3 Use the middle of the mark 3 gate as a reference position for laying the finishing line.



11 Slalom Finish



12 Anchor Retrieval

The following technique is useful when the anchor and chain is heavy or when the warp is long (greater than 30 metres).

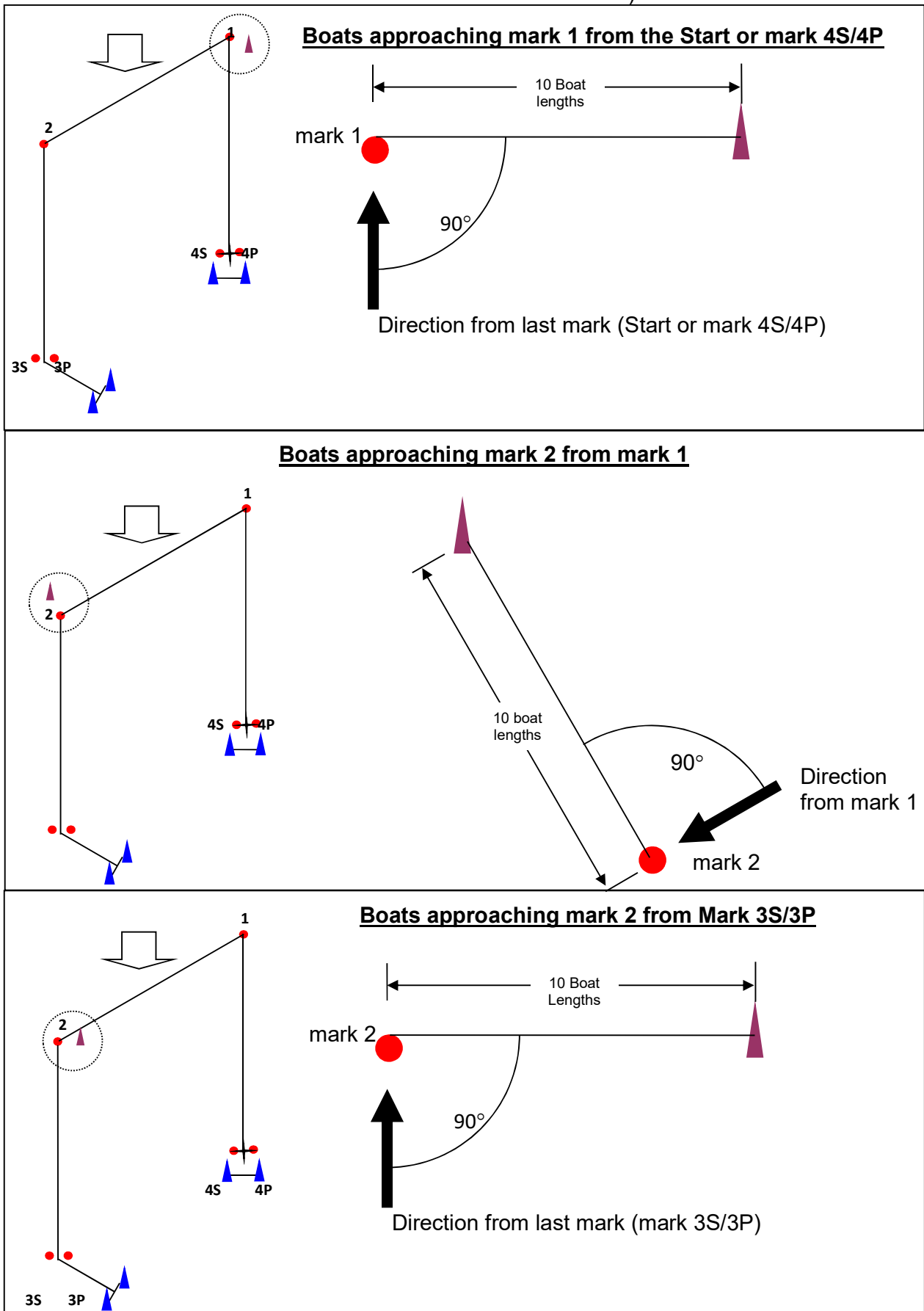
- 12.1 Approach the mark from downwind or down current in the normal way and retrieve the mark and counterweight.
- 12.2 Tie off the warp to a strong point on the hull of the mark vessel.
- 12.3 Attach the retrieval buoy to the warp and allow it to slide down the warp into the water.
- 12.4 Motor away (upwind or up current) at a speed of about 5 knots and at an angle of about thirty degrees from the direction of where the anchor is thought to be.
- 12.5 Ensure at all times that the warp is clear of the motor and propellers.
- 12.6 The retrieval buoy will slide down the anchor warp. It will be clear when it has reached the anchor as there will be more spray around the buoy.
- 12.7 Stop and then return slowly towards the retrieval buoy hauling in the warp.
- 12.8 Repeat if necessary.

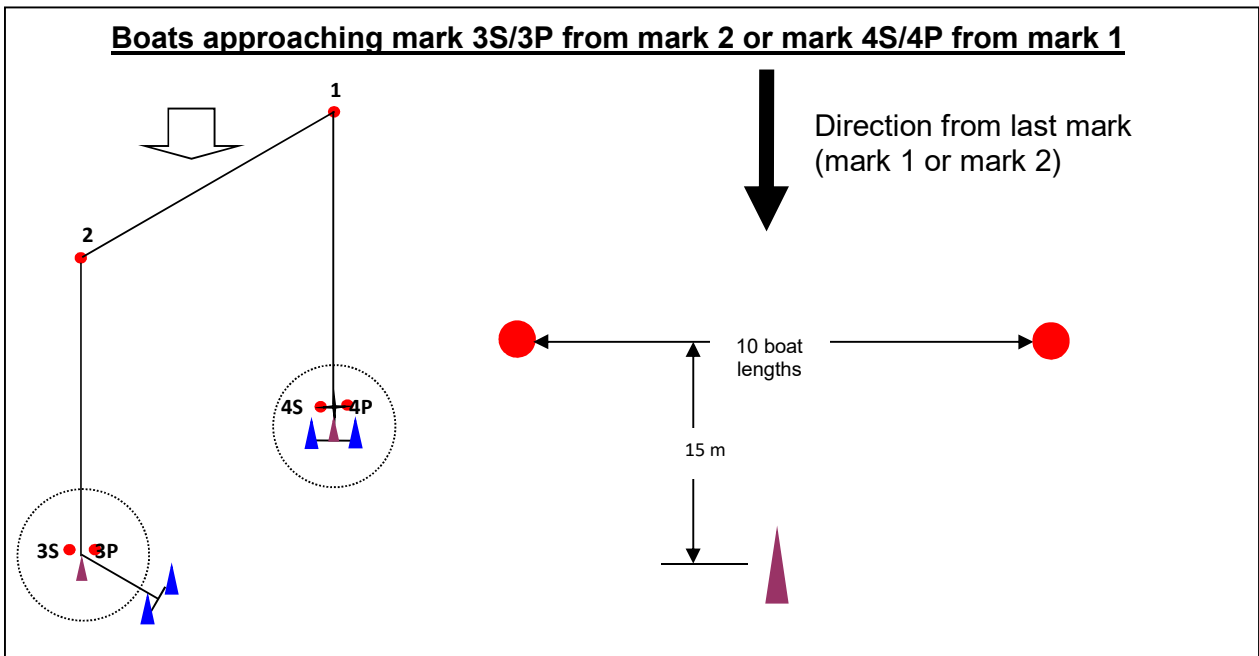
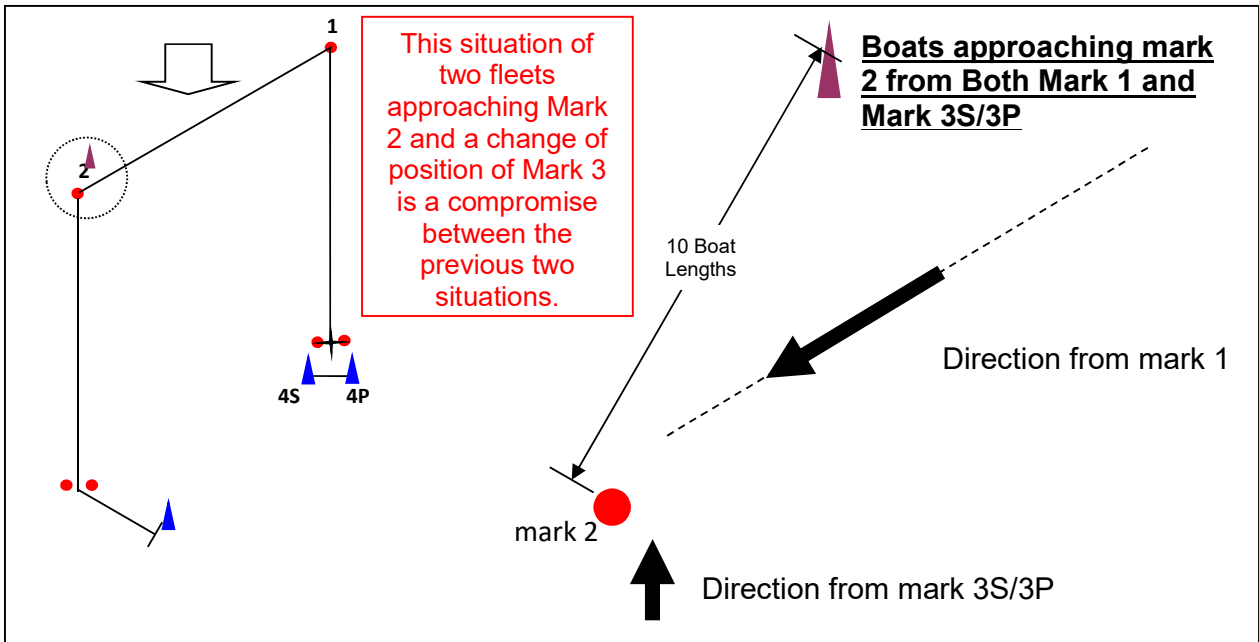
How does the Anchor Ring work?

1. Slip the Anchor Ring over the anchor line. Attach the shackle-buoy assembly. Be sure to snap the shackle through both eyes of the ring. Toss the buoy into the water allowing the ring to slide down the line.
2. Motor your boat at a 30 degree angle off of your anchor point, taking care to keep the anchor line clear of the props. Proceed slowly (roughly 5 knots) until the anchor is released from the bottom. Then increase speed slightly (6 to 8 knots).
3. The anchor line will slide through the ring as the buoy floats to the surface. Once the anchor has reached the surface, shift into neutral and pull in the slack anchor line and anchor. The anchor chain will counterbalance the anchor and hold the anchor at the surface.

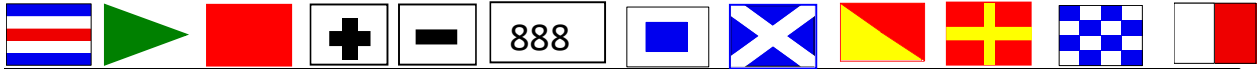


13 Positions of Course Change Signal vessels. (and vessels signalling the turning on and off of Rule 42 or for a finish line for a shortened course)





14 Visual Signals displayed by Mark Vessels



Change of Course - Flag C		
	(- - - - -) Repetitive sounds while the signal is displayed	The position of the next <i>mark</i> has been changed. This signal is displayed with a red rectangle or green triangle for boats without compasses or with a board displaying the compass bearing of the next mark for other classes. Displayed with a board showing a "+" means the length of the leg has been increased. Displayed with a board showing a "-" means the length of the leg has been reduced.
Example	(- - - - -) Repetitive sounds while the signal is displayed	Displayed on courses where the racing boats do not have compasses, means the next mark is to starboard of the original.
Example	(- - - - -) Repetitive sounds while the signal is displayed	This signal means the direction of the next leg for the laser class is 040° and it has been increased length.
Shorten Course – Flag S		
	• •	The course has been shortened. Rule 32.2 is in effect. Display as soon as the leading boat can hear and see the signal. Two sounds once for the first boat only.
Mark Missing – Flag M		
	(- - - - -) Repetitive sounds while the signal is displayed	The object displaying this signal replaces a missing <i>mark</i> .
Changes to Rule 42 – Flags O and R for 470 and Finn classes		
O R	(- - - - -) Repetitive sounds while the signal is displayed	Flag O turns Off aspects of Rule 42. Flag R Returns all of Rule 42.
Abandonment – Flag N and N over H		
	• • •	All races that have started are <i>abandoned</i> . Return to the starting area.
	• • •	All races are <i>abandoned</i> . Further signals ashore.

15 Measuring the Wind

Units: Wind speed Knots
Wind Direction Degrees Magnetic

In a drifting boat

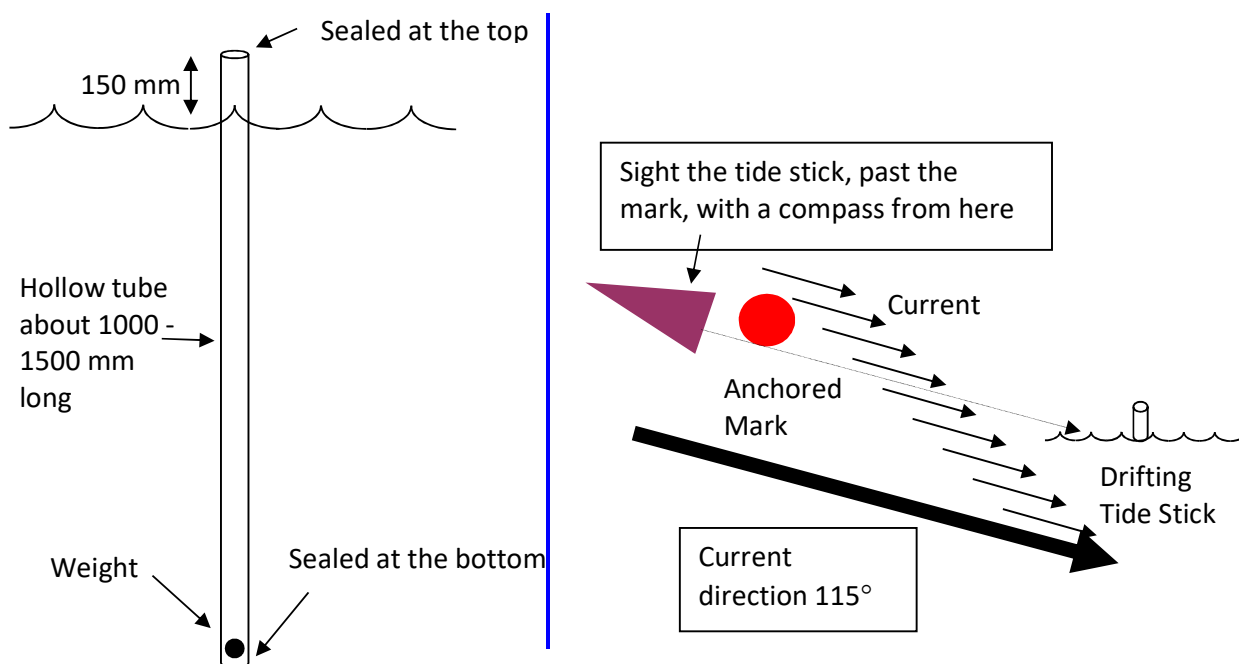
- 15.1 At start minus one hour the wind reader observes the wind speed and direction.
- 15.2 The recorder writes the actual compass direction of the wind direction found at that time on the sheet at the centre/top of the graph and on each side of this figure he/she adds or subtracts 5 degree increments.
- 15.3 It is best to have a wind reader and a recorder working together.
- 15.4 For the first half hour record the time, wind direction and speed. Mark on the graphs with a dot the speed and direction.
- 15.5 After the first half hour, connect the dots, which will give you a graph. Draw a coloured vertical line down the centre of all the direction dots which will give you an average wind direction for the first half hour.
- 15.6 At 55 minutes with a coloured marker draw another vertical line down the centre of the dots for the second half hour.
- 15.7 Repeat every half hour.



16 Measuring the Current

Tide Stick

A tide stick is a piece of hollow tube sealed at both ends so it is watertight. Just sufficient weight is added to one end so the top of the stick floats about 150 mm above the water.



To measure the current, throw the tide stick next to an object that is anchored to the seabed. Time the movement of the stick. Use a hand bearing compass to measure the direction of movement by standing on station behind the stationary object and measure towards the tide stick.

Estimate the distance travelled over the time taken and use the formula below to calculate the speed of the current.

$$\text{Speed in knots} = \frac{\text{Twice the distance in metres}}{\text{Time in seconds}}$$

Examples

- (i) A stick moved 135 m in 1 minute and 40 seconds.
(Use rangefinder to measure the distance)

$$\begin{aligned}\text{Speed in Knots} &= 2 \times 135 \div 100 \\ &= 2.7 \text{ knots}\end{aligned}$$

- (ii) A stick is estimated to have moved 12 m (2 boat lengths) in 1 minute.

$$\begin{aligned}\text{Speed in Knots} &= 2 \times 12 \div 60 \\ &= 0.4 \text{ knot}\end{aligned}$$

When there is no stationary object but there is a strong current stop the vessel and allow it to drift. Use the GPS to note any speed and direction over the seabed.

17 Mark and Safety Vessels Equipment

Mark vessels must be of sufficient size to withstand the worst conditions that could possibly be expected in the worst-case scenario.

Safety Equipment for all vessels

Safety plan for the event

Lifejacket for each crew member

Bungs (and spare)

Anchor chain and warp at least 6 times the depth of the deepest water

Tow Rope.

5 yellow ribbons to tie to the forestay of any yacht left without a crew.

Bailer (Bucket and lanyard)

Tools, shackle key on a float and a sharp knife

First Aid Kit and sunscreen lotion

VHF radio and a secondary means of communication (Mobile phone or Flares(2))

Spare fuel

Food and drink

Clipboard, pencils and paper including some waterproof paper.

Sailing Instructions including amendments

List of Competitors

Mark laying equipment

Mark(s)

Alternate mark(s)

Anchor chain and warp – 1 more than the total number of marks carried.

Anchor retrieval ring and retrieval buoy.

Flags H, M, N, S (O and R for Finns, Europes, 470, 420, 29ers)

Class Flags if more than one class on the course.

Course Change board – C, Red rectangle, Green Triangle, +, -, Compass bearing

Horn

Mark Rounding/finish Sheets

Hand bearing compass

Wind direction indicator

Anemometer

Clock or watch set to GPS time

GPS

Tide stick

Rangefinder if possible

Sailing Instructions including amendments

List of Competitors

Sailing Instruction Summary

Regatta	Date
Classes /Course Areas/ROs	

	Time	Comment
VHF Channel		
Warning Signal delay after D displayed		
Warning Signal delay after AP removed		
Time 1 st warning signal on first day		
Time 1 st warning signal on subsequent days		
Time of last warning signal on last day		
Time for orange flag displayed before warning signal		
Time before DNS applied		
Time for individual recall displayed (if not 4 minutes)		
Delay for next race after last finisher in previous race		
Delay for warning signal for subsequent starts		
First mark time limit		
Race Time Limit		
Target Time		
Time before DNF applied		
Protest Time Limit after last boat		
Extra races per day		
Races to complete series		
Number of races before exclusion		
Time for change of SIs		
Time for change of schedule		
Do boats have to report protests to committee vessel at finish?		

Acknowledgement to Nigel Hayton for the idea of this form

Signal Vessel Data Sheet - Weather

Event _____ Date _____

Committee Boat _____ RO _____

Personnel

Weather: Wind Warning

Situation:

Forecast:

Barometric Pressure:

Tides:

Tidal Range:

Nowcasting:

Time	Cl			Tir			BR			TS			KH			MH			Tut			
	Pk	Av	Fr	Pk	Av	Fr	Pk	Av	Fr	Pk	Av	Fr	Pk	Av	Fr	Pk	Av	Fr	Pk	Av	Fr	

Pre-start check list for Signal Vessel

- Weather check, tides and nowcasting (Channel 21)
- Check with Shore Base about expected number of competitors
- Competitor check sheet ready and being ticked
- Sound Signal (Horn, Bell, Gun) checked
- Back-up sound signal ready (hand horn or whistle)
- Watch set to GPS time
- Time check done with the Race Officer and Pin End vessel
- Radio check with all committee vessels
- Warning and Preparatory flags ready
- Tape Recorder/Dictaphone checked
- X (Individual Recall) and 1st Substitute (General Recall) ready
- AP and L ready and N available
- Times sheet written up for starting sequence
- RO informed of 30 mins
- 15 mins
- 10 mins
- 5 mins
- Compass Direction Board posted
- Distance to Mark 1 posted
- Course Designation posted
- **JUST AFTER START**
- Record wind strength and direction at start time
- Look for boats returning
- Count the number of starters and reconcile with sail number check.
- Record OCS and transfer to Finish Sheet (or transmit to finish boat by phone)
- Transmit to mark vessels and shore base the number of starters
- **DURING THE RACE**
- Record time of first and last boat of each division at each mark and wind strength and direction
- Record the elapsed time for each leg and try to estimate finish times to assist RO with decision of next start time
- Record any course changes
- Put up Blue Shape for the finish when first boat rounds penultimate mark
- Have course board and warning signal board ready to display after the first finisher with Flag L
- Record sail number and time of each boat at finish. Record any visible protest flags.
- **If the last race of the day, notify Shore Base of last finisher for protest time**

Wind Speed and Direction Event _____ Date _____
 Position on the course Signal Vessel Start Pin Mark 1 Mark 2 Mark 3 Mark 4 Mark 5 Finish
 Race Number _____ Recorder _____

Speed	Direction	Time	0	5	0	5	0	5	0	5	0	5	0	5	0	5	0	5	0	5	
			__:00																		
__:05																					
__:10																					
__:15																					
__:20																					
__:25																					
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__:55																					

Rounding / Finish Sheet	Event 2016 Zephyr National Championships	Manly Sailing Club
Race number	Date	Recorder

Position: Shore	SignalBoat	Start Pin	Mark 1	Mark 2	Mark 3	Mark 1 2nd time	Mark 3 2nd time	Finish	Finish Pin
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Wind Direction	Wind Speed
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Sequential List				Zephyr			
1	31	61	91	8		113	308
2	32	62	92	9		119	316
3	33	63	93	10		120	323
4	34	64	94	11		131	
5	35	65	95	14			
6	36	66	96	15			
7	37	67	97	17			
8	38	68	98	19			504
9	39	69	99	24			508
10	40	70	100				509
11	41	71	101				511
12	42	72	102			61	512
13	43	73	103			171	513
14	44	74				173	516
15	45	75				177	517
16	46	76				179	519
17	47	77		64		182	520
18	48			69		185	521
19	49			82		188	522
20	50			84		190	523
21	51			88		200	524
22			112	89		211	525
23	53		113	91		217	526
24	54		114	92		220	527
25	55	85	115	101		251	528
26	56	86	116	103		252	529
27	57	87	117	104		254	
28	58	88	118	107		257	
29	59	89	119	109		258	
30	60	89	120	111		301	

This is an example of a sheet suitable for mark roundings and finishes. The ordered list of the entry list should be reconciled with the sequential recording by ticking in the relevant square. This is an easy method of keeping track of the fleet in a timely manner. Blank copies of this and the other forms can be found at: <http://www.yachtingnz.org.nz/coaches-officials/coachofficial-resources>

Time First	Time Last

Notes

Course Board Dimensions.

The board, made of 4mm foam PVC, is 940 mm x 600 mm.

The C, +/- and green triangle/red rectangle can be A3 laminated card.

This latest version is hinged horizontally to make it easier to stow in a mark laying vessel.



Average VMG for Centreboard Classes

Wind speed (Knots)	3-7	5-10	7-13	10-15	13-18	15-20	18-23	20-25
Optimist		2	2.5	3	3.2	3.6		
P Class		2.4	2.7	2.6				
Starling	3.3	3.5	3.7	3.9	4.1	4		
Splash		3.2	3.6	4	4.4	4.6	4.6	
Laser Radial		3.4	4.2	4.5	5.1	5.3	5.4	5.4
Europe	3	3.5	4	4.1	4.6	5	5.3	
Laser		3.7	4.5	4.9	5.4	5.6	5.7	5.7
Finn	3.3	3.8	4.1	4.8	5.5	6	6.5	6.4
Laser II		5.4		5.8				
420				4.7	5.1	6.2	6.6	
470	3.1	4	5	5.5	6	6.4	6.8	6.9
49er		4.6	7.3	8.7	10	10	10	
Mistral	5.5	6	7			8.1	9.3	12
Tornado	4.1	5.1	6	6.8	7.3	7.8		
Etchell					5.7	5.8	6	6.2
RS:X Men	3.8	4.5	5	7.8	9	9.8	10.5	11.5
RS:X Women	3.3	3.6	4	6.2	7	7.8	8.9	9.5
OK		3.5	3.7	4.1	4.5	4.7	4.9	

The speeds (in knots) given above are based on an average speed made good around a typical triangular, trapezoidal or windward/leeward course for the leading boat.

Distance (nautical miles) = Speed (knots) × Time (hours)

The speeds given above are a guide only. Thought needs to be given to sea conditions and the experience of the competitors when determining the length of the course.

To use the table above

- Find the target time from the sailing instructions
- Calculate the distance to be sailed (VMG × target time in hours)
- Go to the table of the course to be sailed to find the closest total distance for that course.
- Read off the length from reference point (Mark 4 or Mark 3) to Mark 1 (Beat Length)

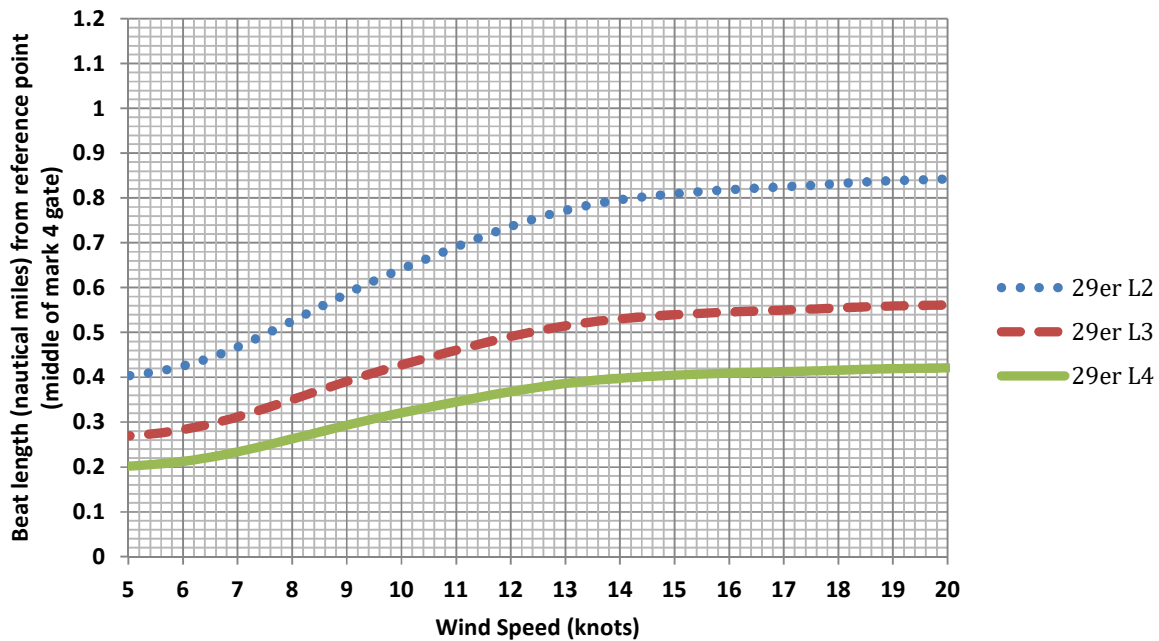
The table below is useful, particularly in the protest room, to help determine how far boats have travelled.

Speed in Knots and metres per second												
Knots	1	2	3	4	5	6	7	8	9	10	11	12
m/s	0.5	1	1.5	2.1	2.6	3.1	3.6	4.1	4.6	5.1	5.7	6.2

For example: A boat travelling at 6 knots travels just over 3 metres every second.

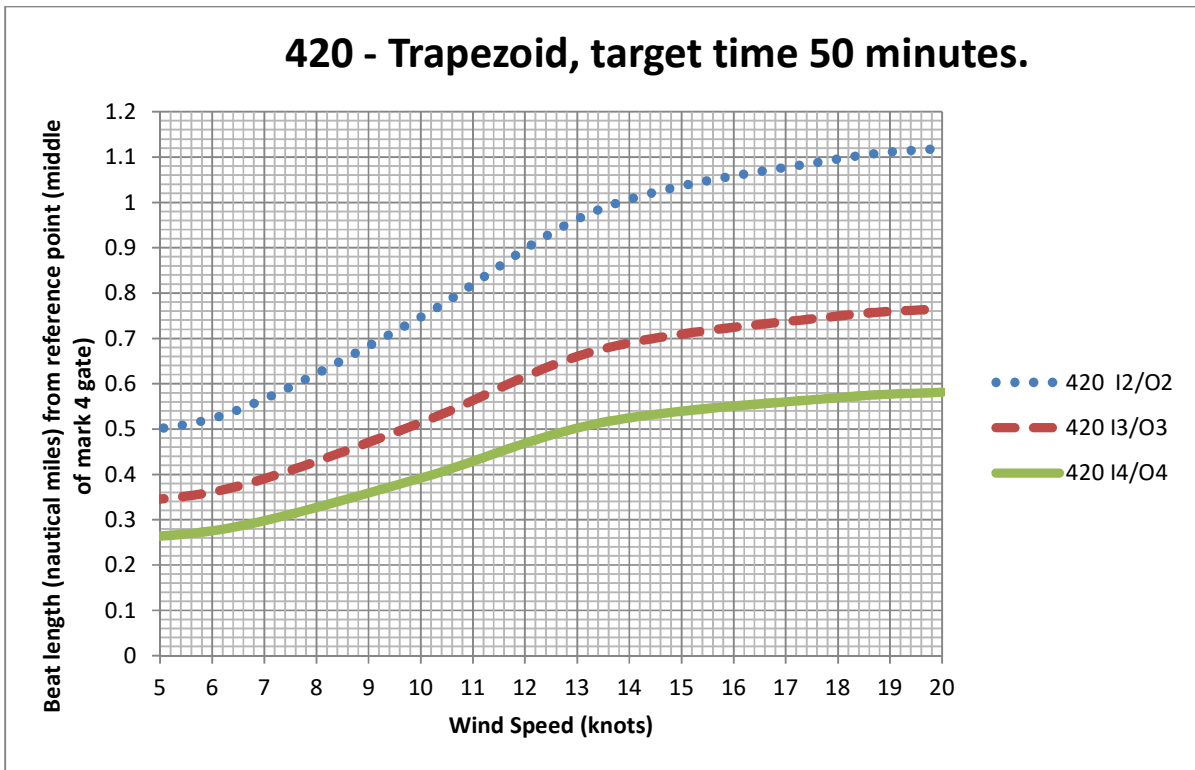
The graphs on pages 68 - 103 are derived from information compiled by the RYA, in particular by David Campbell-James. The base data in the form of an excel spreadsheet can be found at <http://www.rya.org.uk/racing/raceofficials/resourcecentre/standard/Pages/DataReference.aspx>

29er - Leeward, target time 30 minutes.



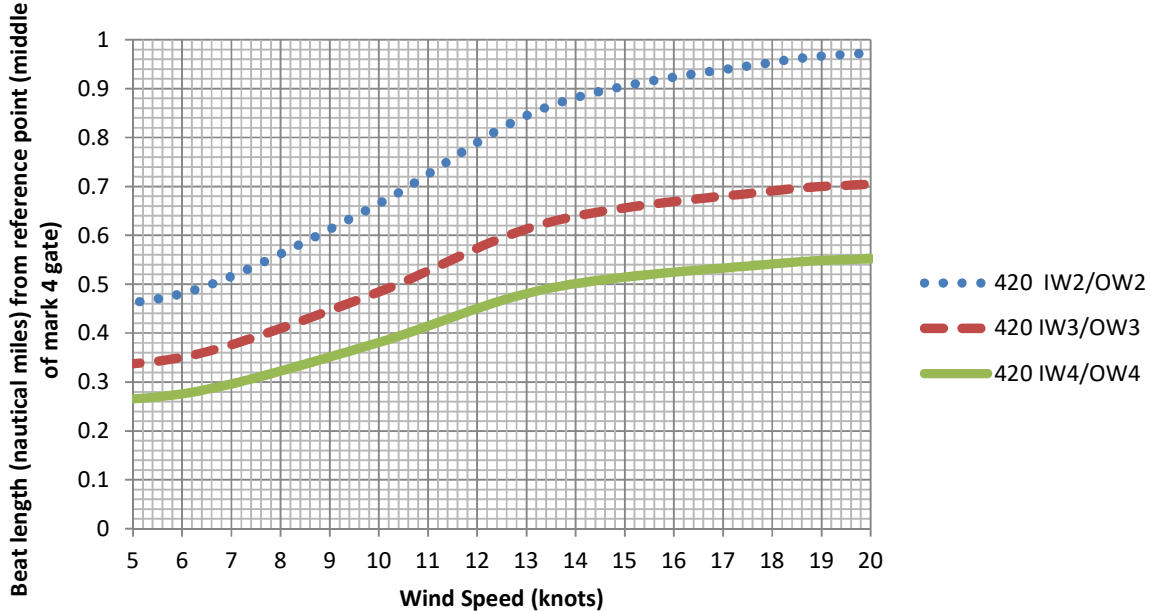
Anticipated leg times for 29er Leeward with race target time of 30 minutes									
Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.44		0.64		0.79		0.83	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.9	9.9	10.4	10.4	10.4	10.4	10.6	10.6
	1 to 4	5.3	15.2	4.8	15.2	4.7	15.2	4.6	15.2
	4 to 1	8.9	24.1	9.6	24.8	9.8	25.0	10.0	25.1
	1 to Finish	5.9	30.0	5.2	30.0	5.0	30.0	4.9	30.0
L3	Leg Length	0.30		0.43		0.52		0.55	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	6.9	6.9	7.2	7.2	7.2	7.2	7.3	7.3
	1 to 4	3.6	10.5	3.2	10.4	3.1	10.3	3.1	10.3
	4 to 1	5.9	16.4	6.4	16.8	6.5	16.9	6.7	17.0
	1 to 4	3.6	19.9	3.2	20.0	3.1	20.0	3.1	20.0
L4	Leg Length	0.22		0.32		0.39		0.42	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	5.4	5.4	5.6	5.6	5.5	5.5	5.6	5.6
	1 to 4	2.7	8.1	2.4	8.0	2.4	7.9	2.3	7.9
	4 to 1	4.4	12.5	4.8	12.8	4.9	12.8	5.0	12.9
	1 to 4	2.7	15.2	2.4	15.2	2.4	15.2	2.3	15.2
	4 to 1	4.4	19.6	4.8	20.0	4.9	20.1	5.0	20.2
	1 to 4	2.7	22.3	2.4	22.4	2.4	22.4	2.3	22.4
4 to 1	4.4	26.7	4.8	27.2	4.9	27.3	5.0	27.4	
1 to Finish	3.3	30.0	2.8	30.0	2.7	30.0	2.6	30.0	

420 - Trapezoid, target time 50 minutes.



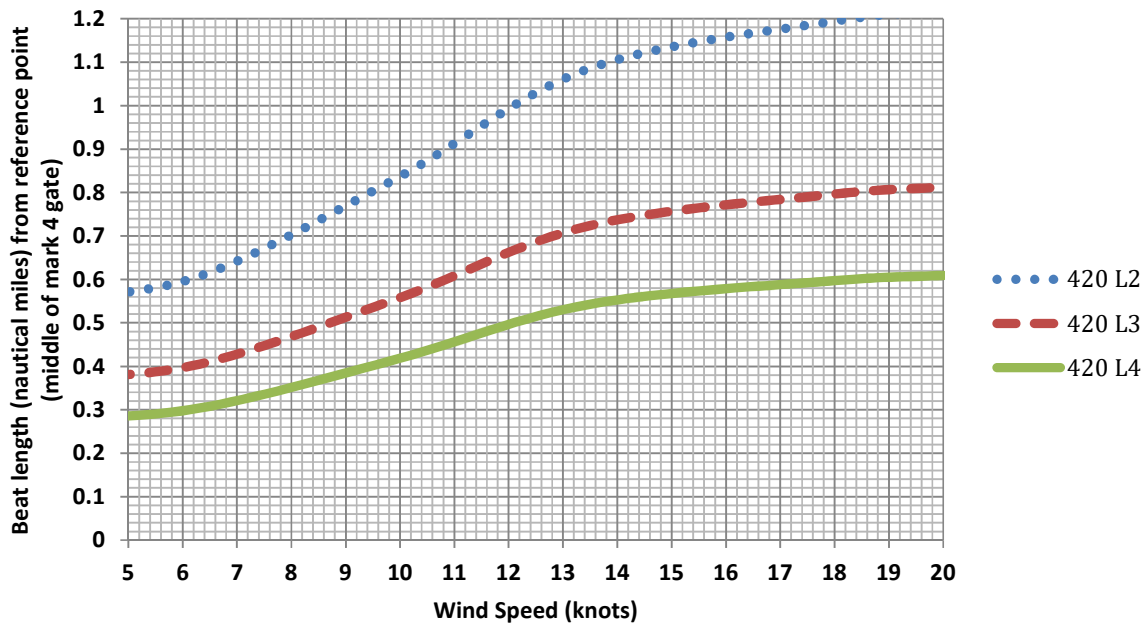
Anticipated leg times for 420 Trapezoid with a race target time 50 minutes																					
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+			
Average beat		0.54		0.75		0.99		1.10		Average beat		0.54		0.75		0.99		1.10			
I2		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O2		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	12.4	12.4	13.5	13.5	14.5	14.5	15.5	15.5		12.4	12.4	13.5	13.5	14.5	14.5	15.5	15.5	15.5	15.5	
	1 to 4	9.8	22.2	9.0	22.5	8.4	22.9	7.7	23.1		4.7	17.1	4.5	18.0	4.0	18.5	3.7	19.1	3.7	19.1	
	4 to 1	11.4	33.6	12.7	35.2	13.8	36.8	14.8	37.9		9.8	26.9	9.0	27.0	8.4	26.9	7.7	26.8	7.7	26.8	
	1 to 2	4.7	38.3	4.5	39.7	4.0	40.7	3.7	41.6		11.4	38.3	12.7	39.7	13.8	40.7	14.8	41.6	14.8	41.6	
	2 to 3	9.8	48.1	9.0	48.7	8.4	49.1	7.7	49.3		2 to 3	9.8	48.1	9.0	48.7	8.4	49.1	7.7	49.3	7.7	49.3
	3 to Finish	2.0	50.0	1.4	50.0	0.9	50.0	0.8	50.0		3 to Finish	2.0	50.0	1.4	50.0	0.9	50.0	0.8	50.0	0.8	50.0
	Average beat	0.54		0.75		0.99		1.10			Average beat		0.54		0.75		0.99		1.10		
I3		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O3		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	8.9	8.9	9.6	9.6	10.2	10.2	10.8	10.8		8.9	8.9	9.6	9.6	10.2	10.2	10.8	10.8	10.8	10.8	
	1 to 4	6.7	15.6	6.2	15.8	5.8	15.9	5.2	16.0		3.2	12.1	3.1	12.7	2.7	12.9	2.5	13.3	2.5	13.3	
	4 to 1	7.9	23.5	8.7	24.5	9.5	25.4	10.1	26.1		6.7	18.9	6.2	18.8	5.8	18.6	5.2	18.5	5.2	18.5	
	1 to 4	6.7	30.2	6.2	30.7	5.8	31.2	5.2	31.4		7.9	26.7	8.7	27.6	9.5	28.1	10.1	28.6	10.1	28.6	
	4 to 1	7.9	38.1	8.7	39.4	9.5	40.6	10.1	41.5		2 to 3	6.7	33.5	6.2	33.7	5.8	33.9	5.2	33.9	5.2	33.9
	1 to 2	3.2	41.3	3.1	42.5	2.7	43.3	2.5	44.0		3 to 2	7.9	41.3	8.7	42.5	9.5	43.3	10.1	44.0	10.1	44.0
	2 to 3	6.7	48.1	6.2	48.7	5.8	49.1	5.2	49.3		2 to 3	6.7	48.1	6.2	48.7	5.8	49.1	5.2	49.3	5.2	49.3
3 to Finish	2.0	50.0	1.4	50.0	0.9	50.0	0.8	50.0	3 to Finish	2.0	50.0	1.4	50.0	0.9	50.0	0.8	50.0	0.8	50.0		
Average beat	0.37		0.51		0.68		0.75		Average beat		0.37		0.51		0.68		0.75				
I4		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O4		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	7.0	7.0	7.5	7.5	7.9	7.9	8.4	8.4		7.0	7.0	7.5	7.5	7.9	7.9	8.4	8.4	8.4	8.4	
	1 to 4	5.1	12.2	4.7	12.2	4.4	12.3	4.0	12.3		2.5	9.5	2.4	9.9	2.1	10.0	1.9	10.3	1.9	10.3	
	4 to 1	6.0	18.2	6.7	18.9	7.2	19.5	7.7	20.0		5.1	14.7	4.7	14.6	4.4	14.3	4.0	14.2	4.0	14.2	
	1 to 4	5.1	23.3	4.7	23.6	4.4	23.9	4.0	24.0		6.0	20.6	6.7	21.2	7.2	21.6	7.7	21.9	7.7	21.9	
	4 to 1	6.0	29.3	6.7	30.2	7.2	31.1	7.7	31.7		2 to 3	5.1	25.8	4.7	25.9	4.4	25.9	4.0	25.9	4.0	25.9
	1 to 4	5.1	34.4	4.7	34.9	4.4	35.5	4.0	35.7		3 to 2	6.0	31.8	6.7	32.6	7.2	33.1	7.7	33.6	7.7	33.6
	4 to 1	6.0	40.4	6.7	41.6	7.2	42.7	7.7	43.4		2 to 3	5.1	36.9	4.7	37.3	4.4	37.5	4.0	37.6	4.0	37.6
1 to 2	2.5	42.9	2.4	43.9	2.1	44.7	1.9	45.3	3 to 2	6.0	42.9	6.7	43.9	7.2	44.7	7.7	45.3	7.7	45.3		
2 to 3	5.1	48.1	4.7	48.7	4.4	49.1	4.0	49.3	2 to 3	5.1	48.1	4.7	48.7	4.4	49.1	4.0	49.3	4.0	49.3		
3 to Finish	2.0	50.0	1.4	50.0	0.9	50.0	0.8	50.0	3 to Finish	2.0	50.0	1.4	50.0	0.9	50.0	0.8	50.0	0.8	50.0		
Average beat	0.29		0.39		0.51		0.57		Average beat		0.29		0.39		0.51		0.57				

420 - Trapezoid with beat to finish, target time 50 minutes.



Anticipated leg times for 420 Trapezoid with beat to finish with a race target time 50 minutes																			
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+	
Average beat		0.49		0.65		0.85		0.94		Average beat		0.49		0.65		0.85		0.94	
		Leg time		Leg time		Leg time		Leg time				Leg time		Leg time		Leg time		Leg time	
		time	Total	time	Total	time	Total	time	Total			time	Total	time	Total	time	Total	time	Total
12	Start to 1	11.3	11.3	12.0	12.0	12.7	12.7	13.4	13.4	02	Start to 1	11.3	11.3	12.0	12.0	12.7	12.7	13.4	13.4
	1 to 4	8.8	20.0	7.8	19.8	7.3	19.9	6.6	20.0		1 to 2	4.2	15.5	3.9	15.9	3.4	16.1	3.1	16.5
	4 to 1	10.2	30.2	11.1	30.9	12.0	31.9	12.7	32.7		2 to 3	8.8	24.2	7.8	23.7	7.3	23.3	6.6	23.1
	1 to 2	4.2	34.5	3.9	34.9	3.4	35.3	3.1	35.8		3 to 2	10.2	34.5	11.1	34.9	12.0	35.3	12.7	35.8
	2 to 3	8.8	43.2	7.8	42.7	7.3	42.5	6.6	42.4		2 to 3	8.8	43.2	7.8	42.7	7.3	42.5	6.6	42.4
	3 to 5	4.2	47.4	3.9	46.6	3.4	45.9	3.1	45.6		3 to 5	4.2	47.4	3.9	46.6	3.4	45.9	3.1	45.6
	5 to Finish	2.6	50.0	3.4	50.0	4.1	50.0	4.4	50.0		5 to Finish	2.6	50.0	3.4	50.0	4.1	50.0	4.4	50.0
13	Start to 1	8.5	8.5	8.9	8.9	9.4	9.4	9.9	9.9	03	Start to 1	8.5	8.5	8.9	8.9	9.4	9.4	9.9	9.9
	1 to 4	6.4	14.9	5.7	14.7	5.3	14.6	4.8	14.7		1 to 2	3.1	11.6	2.9	11.8	2.5	11.8	2.3	12.2
	4 to 1	7.4	22.3	8.1	22.8	8.7	23.3	9.2	23.9		2 to 3	6.4	18.0	5.7	17.5	5.3	17.1	4.8	16.9
	1 to 4	6.4	28.7	5.7	28.5	5.3	28.6	4.8	28.6		3 to 2	7.4	25.4	8.1	25.6	8.7	25.8	9.2	26.1
	4 to 1	7.4	36.2	8.1	36.6	8.7	37.2	9.2	37.8		2 to 3	6.4	31.8	5.7	31.3	5.3	31.0	4.8	30.9
	1 to 2	3.1	39.2	2.9	39.4	2.5	39.7	2.3	40.1		3 to 2	7.4	39.2	8.1	39.4	8.7	39.7	9.2	40.1
	2 to 3	6.4	45.6	5.7	45.1	5.3	45.0	4.8	44.9		2 to 3	6.4	45.6	5.7	45.1	5.3	45.0	4.8	44.9
3 to 5	3.1	48.7	2.9	48.0	2.5	47.4	2.3	47.2	3 to 5	3.1	48.7	2.9	48.0	2.5	47.4	2.3	47.2		
5 to Finish	1.3	50.0	2.0	50.0	2.6	50.0	2.8	50.0	5 to Finish	1.3	50.0	2.0	50.0	2.6	50.0	2.8	50.0		
14	Start to 1	6.9	6.9	7.2	7.2	7.5	7.5	7.9	7.9	04	Start to 1	6.9	6.9	7.2	7.2	7.5	7.5	7.9	7.9
	1 to 4	5.0	11.9	4.5	11.7	4.1	11.6	3.7	11.6		1 to 2	2.4	9.3	2.2	9.5	1.9	9.4	1.8	9.7
	4 to 1	5.9	17.8	6.4	18.1	6.8	18.4	7.2	18.8		2 to 3	5.0	14.4	4.5	14.0	4.1	13.6	3.7	13.4
	1 to 4	5.0	22.8	4.5	22.6	4.1	22.6	3.7	22.6		3 to 2	5.9	20.2	6.4	20.3	6.8	20.4	7.2	20.6
	4 to 1	5.9	28.7	6.4	28.9	6.8	29.4	7.2	29.8		2 to 3	5.0	25.2	4.5	24.8	4.1	24.5	3.7	24.4
	1 to 4	5.0	33.7	4.5	33.4	4.1	33.5	3.7	33.5		3 to 2	5.9	31.1	6.4	31.2	6.8	31.3	7.2	31.6
	4 to 1	5.9	39.6	6.4	39.8	6.8	40.3	7.2	40.8		2 to 3	5.0	36.1	4.5	35.7	4.1	35.4	3.7	35.3
1 to 2	2.4	42.0	2.2	42.1	1.9	42.2	1.8	42.5	3 to 2	5.9	42.0	6.4	42.1	6.8	42.2	7.2	42.5		
2 to 3	5.0	47.0	4.5	46.5	4.1	46.4	3.7	46.3	2 to 3	5.0	47.0	4.5	46.5	4.1	46.4	3.7	46.3		
3 to 5	2.4	49.4	2.2	48.8	1.9	48.3	1.8	48.1	3 to 5	2.4	49.4	2.2	48.8	1.9	48.3	1.8	48.1		
5 to Finish	0.6	50.0	1.2	50.0	1.7	50.0	1.9	50.0	5 to Finish	0.6	50.0	1.2	50.0	1.7	50.0	1.9	50.0		

420 - Leeward, target time 50 minutes.

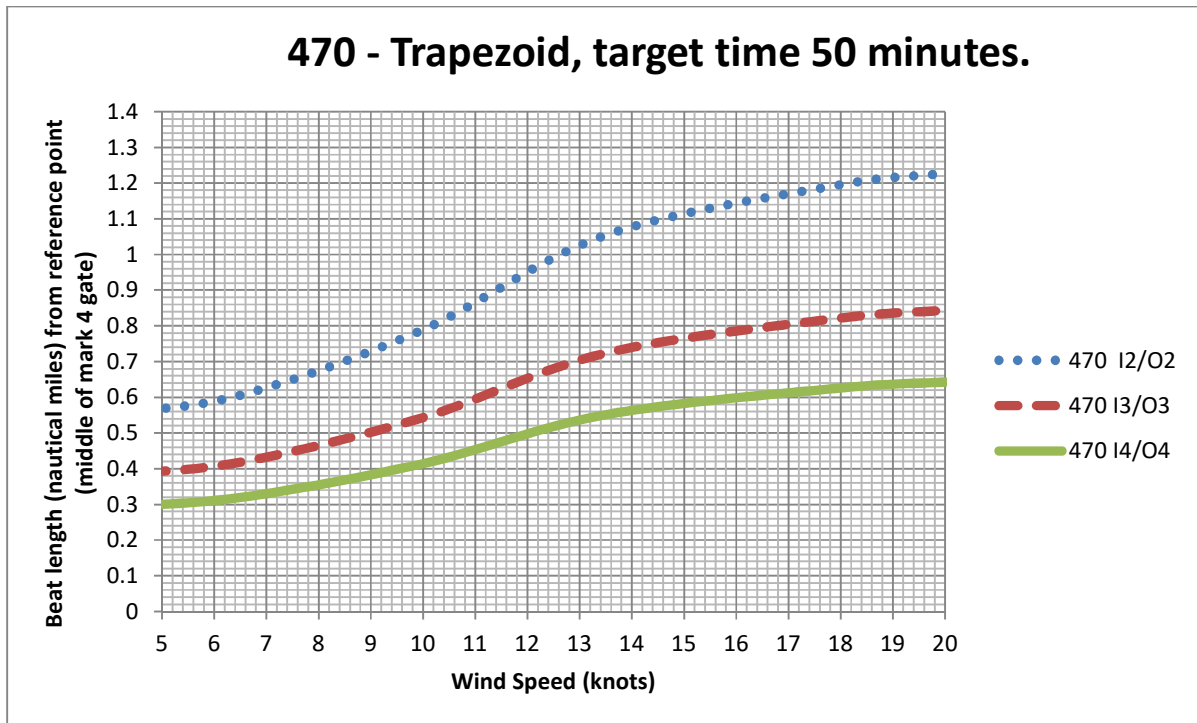


Anticipated leg times for 420 Leeward with race target time of 50 minutes									
Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.62		0.84		1.09		1.19	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	14.0	14.0	15.1	15.1	15.9	15.9	16.8	16.8
	1 to 4	11.1	25.1	10.0	25.1	9.2	25.1	8.4	25.2
	4 to 1	12.9	38.0	14.2	39.4	15.2	40.3	16.1	41.3
	1 to Finish	12.0	50.0	10.6	50.0	9.7	50.0	8.7	50.0
L3	Leg Length	0.41		0.56		0.72		0.80	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.7	9.7	10.3	10.3	10.8	10.8	11.4	11.4
	1 to 4	7.4	17.1	6.7	17.0	6.2	17.0	5.6	17.0
	4 to 1	8.6	25.7	9.5	26.5	10.1	27.1	10.8	27.8
	1 to 4	7.4	33.1	6.7	33.2	6.2	33.3	5.6	33.3
	4 to 1	8.6	41.7	9.5	42.7	10.1	43.4	10.8	44.1
	1 to Finish	8.3	50.0	7.3	50.0	6.6	50.0	5.9	50.0
L4	Leg Length	0.31		0.42		0.54		0.60	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	7.5	7.5	8.0	8.0	8.3	8.3	8.7	8.7
	1 to 4	5.5	13.1	5.0	13.0	4.6	12.9	4.2	12.9
	4 to 1	6.5	19.5	7.1	20.1	7.6	20.5	8.1	21.0
	1 to 4	5.5	25.1	5.0	25.1	4.6	25.1	4.2	25.2
	4 to 1	6.5	31.5	7.1	32.2	7.6	32.7	8.1	33.2
	1 to 4	5.5	37.1	5.0	37.3	4.6	37.4	4.2	37.4
	4 to 1	6.5	43.6	7.1	44.4	7.6	45.0	8.1	45.5
1 to Finish	6.4	50.0	5.6	50.0	5.0	50.0	4.5	50.0	

420 60° 120° Trapezoid with beat to finish (finish 0.05 below the starting line)																				
Wind Range	5 - 8 Knots					8 - 12 Knots					12 - 15 Knots					15+ Knots				
Upwind speed	21 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	17 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	14 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	13.5 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)
Run Speed	18 min/mile					12 min/mile					8.5 min/mile					7 min/mile				
Reach speed	13 min/mile					9 min/mile					6 min/mile					5 min/mile				
Beat length Nautical Miles (Ref to 1)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)
0.30	6.3	5.4	11.7	2.6	1.3	5.1	3.6	8.7	1.8	0.9	4.2	2.6	6.8	1.2	0.6	4.1	2.1	6.2	1.0	0.5
0.35	7.4	6.3	13.7	3.0	1.7	6.0	4.2	10.2	2.1	1.2	4.9	3.0	7.9	1.4	0.8	4.7	2.5	7.2	1.2	0.7
0.40	8.4	7.2	15.6	3.5	2.2	6.8	4.8	11.6	2.4	1.5	5.6	3.4	9.0	1.6	1.0	5.4	2.8	8.2	1.3	0.8
0.45	9.5	8.1	17.6	3.9	2.6	7.7	5.4	13.1	2.7	1.8	6.3	3.8	10.1	1.8	1.2	6.1	3.2	9.2	1.5	1.0
0.50	10.5	9.0	19.5	4.3	3.0	8.5	6.0	14.5	3.0	2.1	7.0	4.3	11.3	2.0	1.4	6.8	3.5	10.3	1.7	1.2
0.55	11.6	9.9	21.5	4.8	3.5	9.4	6.6	16.0	3.3	2.4	7.7	4.7	12.4	2.2	1.6	7.4	3.9	11.3	1.8	1.3
0.60	12.6	10.8	23.4	5.2	3.9	10.2	7.2	17.4	3.6	2.7	8.4	5.1	13.5	2.4	1.8	8.1	4.2	12.3	2.0	1.5
0.65	13.7	11.7	25.4	5.6	4.3	11.1	7.8	18.9	3.9	3.0	9.1	5.5	14.6	2.6	2.0	8.8	4.6	13.3	2.2	1.7
0.70	14.7	12.6	27.3	6.1	4.8	11.9	8.4	20.3	4.2	3.3	9.8	6.0	15.8	2.8	2.2	9.5	4.9	14.4	2.3	1.8
0.75	15.8	13.5	29.3	6.5	5.2	12.8	9.0	21.8	4.5	3.6	10.5	6.4	16.9	3.0	2.4	10.1	5.3	15.4	2.5	2.0
0.80	16.8	14.4	31.2	6.9	5.6	13.6	9.6	23.2	4.8	3.9	11.2	6.8	18.0	3.2	2.6	10.8	5.6	16.4	2.7	2.2
0.85	17.9	15.3	33.2	7.4	6.1	14.5	10.2	24.7	5.1	4.2	11.9	7.2	19.1	3.4	2.8	11.5	6.0	17.4	2.8	2.3
0.90	18.9	16.2	35.1	7.8	6.5	15.3	10.8	26.1	5.4	4.5	12.6	7.7	20.3	3.6	3.0	12.2	6.3	18.5	3.0	2.5
0.95	20.0	17.1	37.1	8.2	6.9	16.2	11.4	27.6	5.7	4.8	13.3	8.1	21.4	3.8	3.2	12.8	6.7	19.5	3.2	2.7
1.00	21.0	18.0	39.0	8.7	7.4	17.0	12.0	29.0	6.0	5.1	14.0	8.5	22.5	4.0	3.4	13.5	7.0	20.5	3.3	2.8
1.05	22.1	18.9	41.0	9.1	7.8	17.9	12.6	30.5	6.3	5.4	14.7	8.9	23.6	4.2	3.6	14.2	7.4	21.5	3.5	3.0
1.10	23.1	19.8	42.9	9.5	8.2	18.7	13.2	31.9	6.6	5.7	15.4	9.4	24.8	4.4	3.8	14.9	7.7	22.6	3.7	3.2
1.15	24.2	20.7	44.9	10.0	8.7	19.6	13.8	33.4	6.9	6.0	16.1	9.8	25.9	4.6	4.0	15.5	8.1	23.6	3.8	3.3
1.20	25.2	21.6	46.8	10.4	9.1	20.4	14.4	34.8	7.2	6.3	16.8	10.2	27.0	4.8	4.2	16.2	8.4	24.6	4.0	3.5
1.25	26.3	22.5	48.8	10.8	9.5	21.3	15.0	36.3	7.5	6.6	17.5	10.6	28.1	5.0	4.4	16.9	8.8	25.6	4.2	3.7
1.30	27.3	23.4	50.7	11.3	10.0	22.1	15.6	37.7	7.8	6.9	18.2	11.1	29.3	5.2	4.6	17.6	9.1	26.7	4.3	3.8
1.35	28.4	24.3	52.7	11.7	10.4	23.0	16.2	39.2	8.1	7.2	18.9	11.5	30.4	5.4	4.8	18.2	9.5	27.7	4.5	4.0
1.40	29.4	25.2	54.6	12.1	10.8	23.8	16.8	40.6	8.4	7.5	19.6	11.9	31.5	5.6	5.0	18.9	9.8	28.7	4.7	4.2

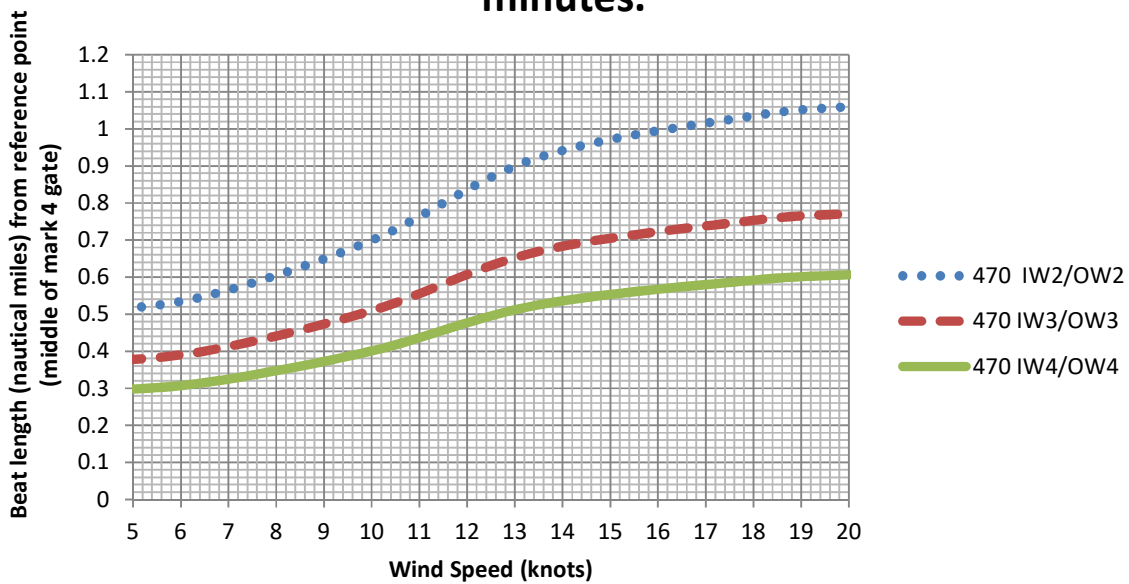
Time from Start to Reference (0.05NM) and Reference to Finish (0.05 NM (Downwind finish))											
0.05	1.1	0.9		0.9	0.6		0.7	0.4		0.7	0.4
Time for reaching leg from gate to finish of 0.15 NM											
0.15			1.95			1.35			0.9		0.8

470 - Trapezoid, target time 50 minutes.



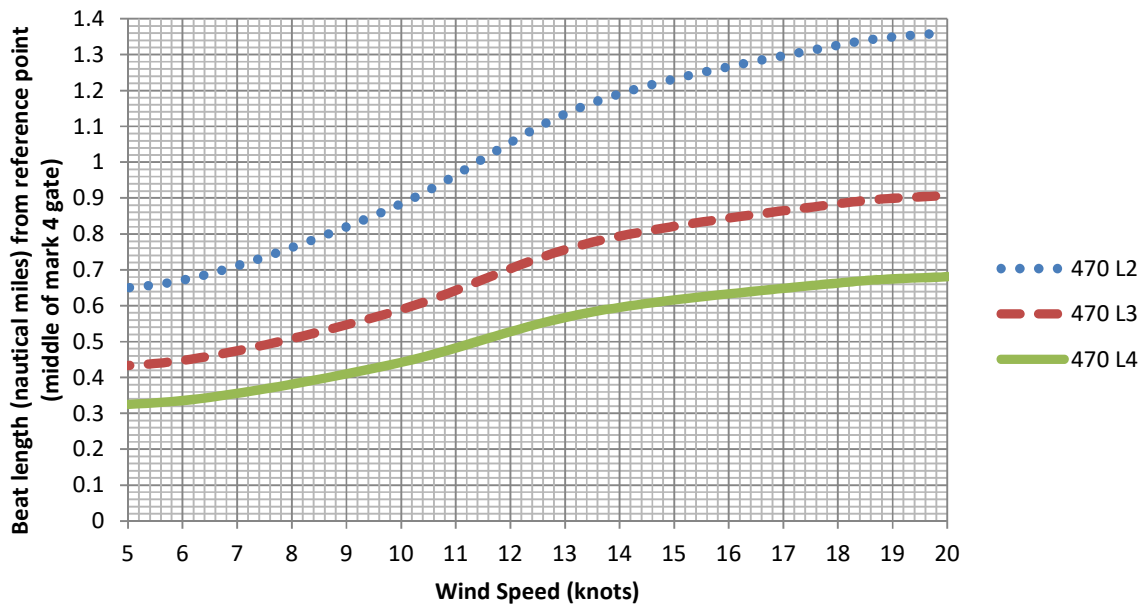
Anticipated leg times for 470 Trapezoid with a race target time 50 minutes																			
Wind Range	5 - 8		8 - 12		12-15		15+		Wind Range	5 - 8		8 - 12		12-15		15+			
Average beat	0.61		0.79		1.05		1.20		Average beat	0.61		0.79		1.05		1.20			
I2	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O2	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	12.5	12.5	13.9	13.9	13.3	13.3	13.7		13.7	Start to 1	12.5	12.5	13.9	13.9	13.3	13.3	13.7	13.7
	1 to 4	9.7	22.2	8.7	22.5	9.5	22.7	9.0		22.7	1 to 2	4.8	17.3	4.5	18.3	4.2	17.5	4.4	18.1
	4 to 1	11.5	33.7	13.0	35.6	12.7	35.4	13.2		35.8	2 to 3	9.7	27.0	8.7	27.0	9.5	27.0	9.0	27.1
	1 to 2	4.8	38.5	4.5	40.0	4.2	39.6	4.4		40.2	3 to 2	11.5	38.5	13.0	40.0	12.7	39.6	13.2	40.2
	2 to 3	9.7	48.2	8.7	48.7	9.5	49.1	9.0		49.2	2 to 3	9.7	48.2	8.7	48.7	9.5	49.1	9.0	49.2
	3 to Finish	1.8	50.0	1.3	50.0	0.9	50.0	0.8		50.0	3 to Finish	1.8	50.0	1.3	50.0	0.9	50.0	0.8	50.0
I3	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O3	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	8.9	8.9	9.8	9.8	9.3	9.3	9.6		9.6	Start to 1	8.9	8.9	9.8	9.8	9.3	9.3	9.6	9.6
	1 to 4	6.7	15.6	6.0	15.8	6.5	15.8	6.2		15.8	1 to 2	3.3	12.2	3.1	12.9	2.9	12.2	3.0	12.6
	4 to 1	7.9	23.5	9.0	24.7	8.7	24.5	9.0		24.8	2 to 3	6.7	18.9	6.0	18.8	6.5	18.7	6.2	18.8
	1 to 4	6.7	30.2	6.0	30.7	6.5	31.0	6.2		31.0	3 to 2	7.9	26.9	9.0	27.8	8.7	27.4	9.0	27.8
	4 to 1	7.9	38.2	9.0	39.7	8.7	39.7	9.0		40.0	2 to 3	6.7	33.6	6.0	33.8	6.5	33.9	6.2	34.0
	1 to 2	3.3	41.5	3.1	42.7	2.9	42.6	3.0		43.0	3 to 2	7.9	41.5	9.0	42.7	8.7	42.6	9.0	43.0
2 to 3	6.7	48.2	6.0	48.7	6.5	49.1	6.2	49.2	2 to 3	6.7	48.2	6.0	48.7	6.5	49.1	6.2	49.2		
3 to Finish	1.8	50.0	1.3	50.0	0.9	50.0	0.8	50.0	3 to Finish	1.8	50.0	1.3	50.0	0.9	50.0	0.8	50.0		
I4	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O4	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	7.0	7.0	7.7	7.7	7.2	7.2	7.4		7.4	Start to 1	7.0	7.0	7.7	7.7	7.2	7.2	7.4	7.4
	1 to 4	5.1	12.1	4.6	12.2	5.0	12.2	4.7		12.1	1 to 2	2.6	9.6	2.3	10.0	2.2	9.4	2.3	9.7
	4 to 1	6.1	18.2	6.8	19.0	6.6	18.8	6.9		19.0	2 to 3	5.1	14.7	4.6	14.6	5.0	14.4	4.7	14.4
	1 to 4	5.1	23.3	4.6	23.6	5.0	23.7	4.7		23.7	3 to 2	6.1	20.7	6.8	21.4	6.6	21.0	6.9	21.3
	4 to 1	6.1	29.4	6.8	30.4	6.6	30.4	6.9		30.6	2 to 3	5.1	25.9	4.6	25.9	5.0	26.0	4.7	26.0
	1 to 4	5.1	34.5	4.6	35.0	5.0	35.3	4.7		35.3	3 to 2	6.1	31.9	6.8	32.8	6.6	32.6	6.9	32.9
4 to 1	6.1	40.5	6.8	41.8	6.6	41.9	6.9	42.2	2 to 3	5.1	37.0	4.6	37.3	5.0	37.5	4.7	37.6		
1 to 2	2.6	43.1	2.3	44.2	2.2	44.1	2.3	44.5	3 to 2	6.1	43.1	6.8	44.2	6.6	44.1	6.9	44.5		
2 to 3	5.1	48.2	4.6	48.7	5.0	49.1	4.7	49.2	2 to 3	5.1	48.2	4.6	48.7	5.0	49.1	4.7	49.2		
3 to Finish	1.8	50.0	1.3	50.0	0.9	50.0	0.8	50.0	3 to Finish	1.8	50.0	1.3	50.0	0.9	50.0	0.8	50.0		

470 - Trapezoid with beat to finish, target time 50 minutes.



Anticipated leg times for 470 Trapezoid with beat to finish with a race target time 50 minutes																			
Wind Range	5 - 8		8 - 12		12-15		15+		Wind Range	5 - 8		8 - 12		12-15		15+			
Average beat	0.54		0.69		0.91		1.02		Average beat	0.54		0.69		0.91		1.02			
	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
12	Start to 1	11.2	11.2	12.2	12.2	11.5	11.5	11.8	11.8	02	Start to 1	11.2	11.2	12.2	12.2	11.5	11.5	11.8	11.8
	1 to 4	8.6	19.8	7.6	19.7	8.2	19.8	7.7	19.5		1 to 2	4.3	15.5	3.9	16.1	3.6	15.2	3.8	15.6
	4 to 1	10.2	30.0	11.4	31.1	10.9	30.7	11.3	30.8		2 to 3	8.6	24.1	7.6	23.6	8.2	23.4	7.7	23.3
	1 to 2	4.3	34.3	3.9	35.0	3.6	34.4	3.8	34.5		3 to 2	10.2	34.3	11.4	35.0	10.9	34.4	11.3	34.5
	2 to 3	8.6	42.9	7.6	42.6	8.2	42.6	7.7	42.2		2 to 3	8.6	42.9	7.6	42.6	8.2	42.6	7.7	42.2
	3 to 5	4.3	47.2	3.9	46.5	3.6	46.2	3.8	46.0		3 to 5	4.3	47.2	3.9	46.5	3.6	46.2	3.8	46.0
5 to Finish	2.8	50.0	3.5	50.0	3.8	50.0	4.0	50.0	5 to Finish	2.8	50.0	3.5	50.0	3.8	50.0	4.0	50.0		
13	0.39		0.50		0.66		0.75		03	0.39		0.50		0.66		0.75			
	Start to 1	8.4	8.4	9.1	9.1	8.5	8.5	8.7		8.7	Start to 1	8.4	8.4	9.1	9.1	8.5	8.5	8.7	8.7
	1 to 4	6.3	14.7	5.5	14.6	6.0	14.5	5.6		14.3	1 to 2	3.1	11.6	2.8	11.9	2.6	11.2	2.7	11.5
	4 to 1	7.5	22.2	8.3	22.9	7.9	22.4	8.2		22.5	2 to 3	6.3	17.8	5.5	17.5	6.0	17.1	5.6	17.1
	1 to 4	6.3	28.5	5.5	28.4	6.0	28.4	5.6		28.1	3 to 2	7.5	25.3	8.3	25.7	7.9	25.1	8.2	25.3
	4 to 1	7.5	35.9	8.3	36.7	7.9	36.3	8.2		36.3	2 to 3	6.3	31.6	5.5	31.2	6.0	31.0	5.6	30.8
1 to 2	3.1	39.1	2.8	39.5	2.6	39.0	2.7	39.0	3 to 2	7.5	39.1	8.3	39.5	7.9	39.0	8.2	39.0		
2 to 3	6.3	45.4	5.5	45.0	6.0	44.9	5.6	44.6	2 to 3	6.3	45.4	5.5	45.0	6.0	44.9	5.6	44.6		
3 to 5	3.1	48.5	2.8	47.9	2.6	47.6	2.7	47.4	3 to 5	3.1	48.5	2.8	47.9	2.6	47.6	2.7	47.4		
5 to Finish	1.5	50.0	2.1	50.0	2.4	50.0	2.6	50.0	5 to Finish	1.5	50.0	2.1	50.0	2.4	50.0	2.6	50.0		
14	0.31		0.39		0.52		0.59		04	0.31		0.39		0.52		0.59			
	Start to 1	6.8	6.8	7.3	7.3	6.8	6.8	7.0		7.0	Start to 1	6.8	6.8	7.3	7.3	6.8	6.8	7.0	7.0
	1 to 4	5.0	11.8	4.3	11.7	4.7	11.5	4.4		11.4	1 to 2	2.5	9.3	2.2	9.6	2.1	8.9	2.1	9.1
	4 to 1	5.9	17.7	6.5	18.2	6.2	17.7	6.4		17.8	2 to 3	5.0	14.3	4.3	13.9	4.7	13.6	4.4	13.5
	1 to 4	5.0	22.6	4.3	22.5	4.7	22.4	4.4		22.2	3 to 2	5.9	20.1	6.5	20.4	6.2	19.8	6.4	20.0
	4 to 1	5.9	28.5	6.5	29.0	6.2	28.6	6.4		28.6	2 to 3	5.0	25.1	4.3	24.8	4.7	24.5	4.4	24.4
1 to 4	5.0	33.4	4.3	33.4	4.7	33.3	4.4	33.0	3 to 2	5.9	31.0	6.5	31.3	6.2	30.7	6.4	30.8		
4 to 1	5.9	39.3	6.5	39.9	6.2	39.5	6.4	39.5	2 to 3	5.0	35.9	4.3	35.6	4.7	35.4	4.4	35.2		
1 to 2	2.5	41.8	2.2	42.1	2.1	41.6	2.1	41.6	3 to 2	5.9	41.8	6.5	42.1	6.2	41.6	6.4	41.6		
2 to 3	5.0	46.7	4.3	46.4	4.7	46.3	4.4	46.0	2 to 3	5.0	46.7	4.3	46.4	4.7	46.3	4.4	46.0		
3 to 5	2.5	49.2	2.2	48.7	2.1	48.4	2.1	48.2	3 to 5	2.5	49.2	2.2	48.7	2.1	48.4	2.1	48.2		
5 to Finish	0.8	50.0	1.3	50.0	1.6	50.0	1.8	50.0	5 to Finish	0.8	50.0	1.3	50.0	1.6	50.0	1.8	50.0		

470 - Leeward, target time 50 minutes.



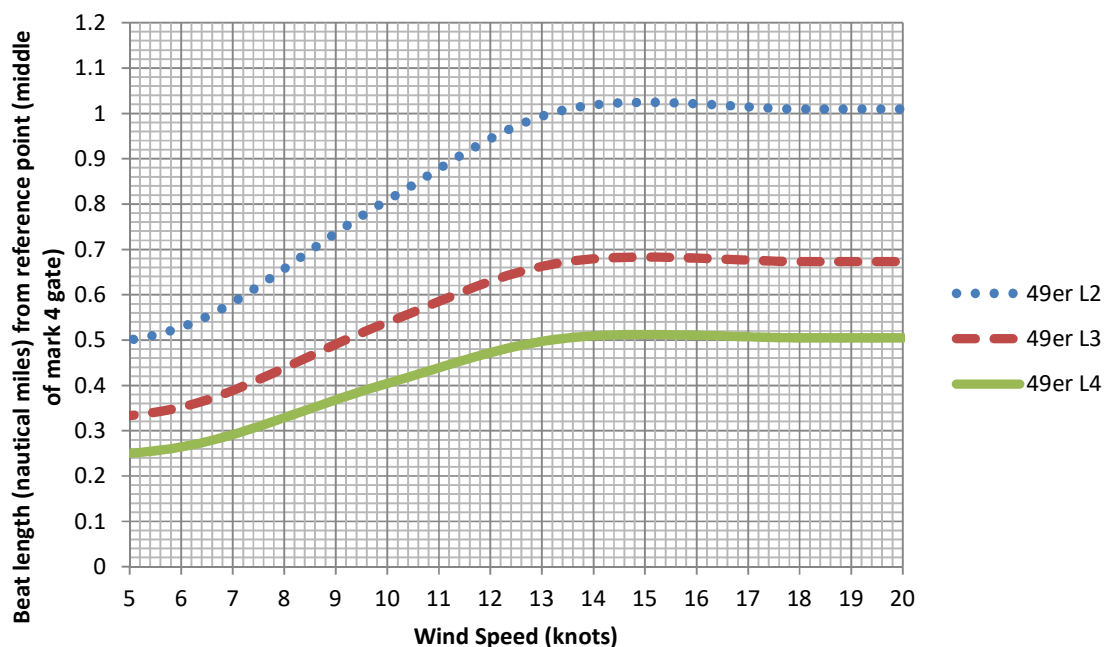
Anticipated leg times for 470 Leeward with race target time of 50 minutes

Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.69		0.88		1.17		1.33	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	14.0	14.0	15.4	15.4	14.6	14.6	15.1	15.1
	1 to 4	11.0	25.1	9.7	25.1	10.5	25.1	9.9	25.1
	4 to 1	13.1	38.2	14.6	39.7	14.0	39.1	14.6	39.7
	1 to Finish	11.8	50.0	10.3	50.0	10.9	50.0	10.3	50.0
L3	Leg Length	0.46		0.59		0.78		0.88	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.7	9.7	10.6	10.6	9.9	9.9	10.3	10.3
	1 to 4	7.4	17.0	6.5	17.0	7.0	16.9	6.6	16.9
	4 to 1	8.7	25.8	9.7	26.8	9.3	26.2	9.7	26.6
	1 to 4	7.4	33.1	6.5	33.2	7.0	33.2	6.6	33.3
	4 to 1	8.7	41.8	9.7	43.0	9.3	42.6	9.7	43.0
1 to Finish	8.2	50.0	7.0	50.0	7.4	50.0	7.0	50.0	
L4	Leg Length	0.34		0.44		0.58		0.66	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	7.5	7.5	8.1	8.1	7.6	7.6	7.8	7.8
	1 to 4	5.5	13.0	4.9	13.0	5.2	12.8	5.0	12.8
	4 to 1	6.5	19.6	7.3	20.3	7.0	19.8	7.3	20.1
	1 to 4	5.5	25.1	4.9	25.1	5.2	25.1	5.0	25.1
	4 to 1	6.5	31.6	7.3	32.4	7.0	32.1	7.3	32.4
	1 to 4	5.5	37.1	4.9	37.3	5.2	37.3	5.0	37.4
	4 to 1	6.5	43.7	7.3	44.6	7.0	44.3	7.3	44.7
1 to Finish	6.3	50.0	5.4	50.0	5.7	50.0	5.3	50.0	

470 60° 120° Trapezoid with beat to finish (finish 0.05 below the starting line)																				
Wind Range	5 - 8 Knots					8 - 12 Knots					12 - 15 Knots					15+ Knots				
Upwind speed	19 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	16.5 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	12 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	11 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)
Run Speed	16 min/mile					11 min/mile					9 min/mile					7.5 min/mile				
Reach speed	12 min/mile					8.5 min/mile					6 min/mile					5.5 min/mile				
Beat length Nautical Miles (Ref to 1)	Up time	Down time	Up and Down			Up time	Down time	Up and Down			Up time	Down time	Up and Down			Up time	Down time	Up and Down		
0.30	5.7	4.8	10.5	2.4	1.2	5.0	3.3	8.3	1.7	0.9	3.6	2.7	6.3	1.2	0.6	3.3	2.3	5.6	1.1	0.6
0.35	6.7	5.6	12.3	2.8	1.6	5.8	3.9	9.6	2.0	1.1	4.2	3.2	7.4	1.4	0.8	3.9	2.6	6.5	1.3	0.7
0.40	7.6	6.4	14.0	3.2	2.0	6.6	4.4	11.0	2.3	1.4	4.8	3.6	8.4	1.6	1.0	4.4	3.0	7.4	1.5	0.9
0.45	8.6	7.2	15.8	3.6	2.4	7.4	5.0	12.4	2.6	1.7	5.4	4.1	9.5	1.8	1.2	5.0	3.4	8.3	1.7	1.1
0.50	9.5	8.0	17.5	4.0	2.8	8.3	5.5	13.8	2.8	2.0	6.0	4.5	10.5	2.0	1.4	5.5	3.8	9.3	1.8	1.3
0.55	10.5	8.8	19.3	4.4	3.2	9.1	6.1	15.1	3.1	2.3	6.6	5.0	11.6	2.2	1.6	6.1	4.1	10.2	2.0	1.5
0.60	11.4	9.6	21.0	4.8	3.6	9.9	6.6	16.5	3.4	2.6	7.2	5.4	12.6	2.4	1.8	6.6	4.5	11.1	2.2	1.7
0.65	12.4	10.4	22.8	5.2	4.0	10.7	7.2	17.9	3.7	2.8	7.8	5.9	13.7	2.6	2.0	7.2	4.9	12.0	2.4	1.8
0.70	13.3	11.2	24.5	5.6	4.4	11.6	7.7	19.3	4.0	3.1	8.4	6.3	14.7	2.8	2.2	7.7	5.3	13.0	2.6	2.0
0.75	14.3	12.0	26.3	6.0	4.8	12.4	8.3	20.6	4.3	3.4	9.0	6.8	15.8	3.0	2.4	8.3	5.6	13.9	2.8	2.2
0.80	15.2	12.8	28.0	6.4	5.2	13.2	8.8	22.0	4.5	3.7	9.6	7.2	16.8	3.2	2.6	8.8	6.0	14.8	2.9	2.4
0.85	16.2	13.6	29.8	6.8	5.6	14.0	9.4	23.4	4.8	4.0	10.2	7.7	17.9	3.4	2.8	9.4	6.4	15.7	3.1	2.6
0.90	17.1	14.4	31.5	7.2	6.0	14.9	9.9	24.8	5.1	4.3	10.8	8.1	18.9	3.6	3.0	9.9	6.8	16.7	3.3	2.8
0.95	18.1	15.2	33.3	7.6	6.4	15.7	10.5	26.1	5.4	4.5	11.4	8.6	20.0	3.8	3.2	10.5	7.1	17.6	3.5	2.9
1.00	19.0	16.0	35.0	8.0	6.8	16.5	11.0	27.5	5.7	4.8	12.0	9.0	21.0	4.0	3.4	11.0	7.5	18.5	3.7	3.1
1.05	20.0	16.8	36.8	8.4	7.2	17.3	11.6	28.9	6.0	5.1	12.6	9.5	22.1	4.2	3.6	11.6	7.9	19.4	3.9	3.3
1.10	20.9	17.6	38.5	8.8	7.6	18.2	12.1	30.3	6.2	5.4	13.2	9.9	23.1	4.4	3.8	12.1	8.3	20.4	4.0	3.5
1.15	21.9	18.4	40.3	9.2	8.0	19.0	12.7	31.6	6.5	5.7	13.8	10.4	24.2	4.6	4.0	12.7	8.6	21.3	4.2	3.7
1.20	22.8	19.2	42.0	9.6	8.4	19.8	13.2	33.0	6.8	6.0	14.4	10.8	25.2	4.8	4.2	13.2	9.0	22.2	4.4	3.9
1.25	23.8	20.0	43.8	10.0	8.8	20.6	13.8	34.4	7.1	6.2	15.0	11.3	26.3	5.0	4.4	13.8	9.4	23.1	4.6	4.0
1.30	24.7	20.8	45.5	10.4	9.2	21.5	14.3	35.8	7.4	6.5	15.6	11.7	27.3	5.2	4.6	14.3	9.8	24.1	4.8	4.2
1.35	25.7	21.6	47.3	10.8	9.6	22.3	14.9	37.1	7.7	6.8	16.2	12.2	28.4	5.4	4.8	14.9	10.1	25.0	5.0	4.4
1.40	26.6	22.4	49.0	11.2	10.0	23.1	15.4	38.5	7.9	7.1	16.8	12.6	29.4	5.6	5.0	15.4	10.5	25.9	5.1	4.6

Time from Start to Reference (0.05NM) and Reference to Finish (0.05 NM (Downwind finish))											
0.05	1.0	0.8		0.8	0.6		0.6	0.5		0.6	0.4
Time for reaching leg from gate to finish of 0.15 NM											
0.15			1.8			1.28			0.9		0.8

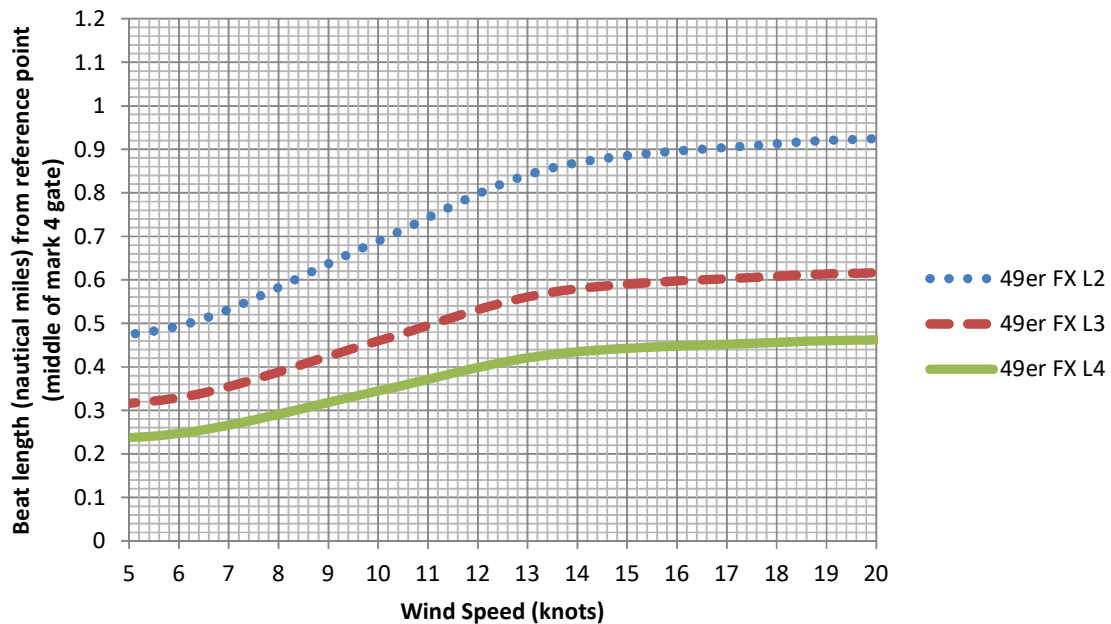
49er - Leeward, target time 30 minutes.



Anticipated leg times for 49er Leeward with race target time of 30 minutes									
Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.55		0.81		1.01		1.01	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.0	9.0	9.4	9.4	9.5	9.5	9.5	9.5
	1 to 4	6.1	15.1	5.7	15.1	5.6	15.1	5.6	15.1
	4 to 1	8.3	23.4	8.9	24.0	9.1	24.2	9.1	24.2
	1 to Finish	6.6	30.0	6.0	30.0	5.8	30.0	5.8	30.0
L3	Leg Length	0.37		0.54		0.67		0.67	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	6.3	6.3	6.5	6.5	6.5	6.5	6.5	6.5
	1 to 4	4.0	10.3	3.8	10.3	3.7	10.2	3.7	10.2
	4 to 1	5.5	15.8	5.9	16.2	6.1	16.3	6.1	16.3
	1 to 4	4.0	19.9	3.8	20.0	3.7	20.0	3.7	20.0
	4 to 1	5.5	25.4	5.9	25.9	6.1	26.0	6.1	26.0
1 to Finish	4.6	30.0	4.1	30.0	4.0	30.0	4.0	30.0	
L4	Leg Length	0.28		0.40		0.50		0.50	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	4.9	4.9	5.0	5.0	5.0	5.0	5.0	5.0
	1 to 4	3.0	7.9	2.8	7.8	2.8	7.8	2.8	7.8
	4 to 1	4.1	12.1	4.4	12.3	4.5	12.3	4.5	12.3
	1 to 4	3.0	15.1	2.8	15.1	2.8	15.1	2.8	15.1
	4 to 1	4.1	19.2	4.4	19.5	4.5	19.6	4.5	19.6
	1 to 4	3.0	22.3	2.8	22.4	2.8	22.4	2.8	22.4
	4 to 1	4.1	26.4	4.4	26.8	4.5	26.9	4.5	26.9
1 to Finish	3.6	30.0	3.2	30.0	3.1	30.0	3.1	30.0	

49er Leeward																		
Wind Range	5 - 8 Knots				8 - 12 Knots				12 - 15 Knots				15+ Knots					
Upwind speed	15 min/mile			Finish on reach leg time (LG/LR)	11 min/mile			Finish on reach leg time (LG/LR)	9 min/mile			Finish on reach leg time (LG/LR)	9 min/mile			Finish on reach leg time (LG/LR)		
Run Speed	11 min/mile				7 min/mile				5.5 min/mile				5.5 min/mile					
Reach speed	8 min/mile				5.5 min/mile				4.5 min/mile				4 min/mile					
Leg length Nautical Miles	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down
0.30	4.5	3.3	7.8	1.2	3.3	2.1	5.4	0.8	2.7	1.7	4.4	0.7	2.7	1.7	4.4	0.6		
0.35	5.3	3.9	9.1	1.2	3.9	2.5	6.3	0.8	3.2	1.9	5.1	0.7	3.2	1.9	5.1	0.6		
0.40	6.0	4.4	10.4	1.2	4.4	2.8	7.2	0.8	3.6	2.2	5.8	0.7	3.6	2.2	5.8	0.6		
0.45	6.8	5.0	11.7	1.2	5.0	3.2	8.1	0.8	4.1	2.5	6.5	0.7	4.1	2.5	6.5	0.6		
0.50	7.5	5.5	13.0	1.2	5.5	3.5	9.0	0.8	4.5	2.8	7.3	0.7	4.5	2.8	7.3	0.6		
0.55	8.3	6.1	14.3	1.2	6.1	3.9	9.9	0.8	5.0	3.0	8.0	0.7	5.0	3.0	8.0	0.6		
0.60	9.0	6.6	15.6	1.2	6.6	4.2	10.8	0.8	5.4	3.3	8.7	0.7	5.4	3.3	8.7	0.6		
0.65	9.8	7.2	16.9	1.2	7.2	4.6	11.7	0.8	5.9	3.6	9.4	0.7	5.9	3.6	9.4	0.6		
0.70	10.5	7.7	18.2	1.2	7.7	4.9	12.6	0.8	6.3	3.9	10.2	0.7	6.3	3.9	10.2	0.6		
0.75	11.3	8.3	19.5	1.2	8.3	5.3	13.5	0.8	6.8	4.1	10.9	0.7	6.8	4.1	10.9	0.6		
0.80	12.0	8.8	20.8	1.2	8.8	5.6	14.4	0.8	7.2	4.4	11.6	0.7	7.2	4.4	11.6	0.6		
0.85	12.8	9.4	22.1	1.2	9.4	6.0	15.3	0.8	7.7	4.7	12.3	0.7	7.7	4.7	12.3	0.6		
0.90	13.5	9.9	23.4	1.2	9.9	6.3	16.2	0.8	8.1	5.0	13.1	0.7	8.1	5.0	13.1	0.6		
0.95	14.3	10.5	24.7	1.2	10.5	6.7	17.1	0.8	8.6	5.2	13.8	0.7	8.6	5.2	13.8	0.6		
1.00	15.0	11.0	26.0	1.2	11.0	7.0	18.0	0.8	9.0	5.5	14.5	0.7	9.0	5.5	14.5	0.6		
1.05	15.8	11.6	27.3	1.2	11.6	7.4	18.9	0.8	9.5	5.8	15.2	0.7	9.5	5.8	15.2	0.6		
1.10	16.5	12.1	28.6	1.2	12.1	7.7	19.8	0.8	9.9	6.1	16.0	0.7	9.9	6.1	16.0	0.6		
1.15	17.3	12.7	29.9	1.2	12.7	8.1	20.7	0.8	10.4	6.3	16.7	0.7	10.4	6.3	16.7	0.6		
1.20	18.0	13.2	31.2	1.2	13.2	8.4	21.6	0.8	10.8	6.6	17.4	0.7	10.8	6.6	17.4	0.6		
1.25	18.8	13.8	32.5	1.2	13.8	8.8	22.5	0.8	11.3	6.9	18.1	0.7	11.3	6.9	18.1	0.6		
1.30	19.5	14.3	33.8	1.2	14.3	9.1	23.4	0.8	11.7	7.2	18.9	0.7	11.7	7.2	18.9	0.6		
1.35	20.3	14.9	35.1	1.2	14.9	9.5	24.3	0.8	12.2	7.4	19.6	0.7	12.2	7.4	19.6	0.6		
1.40	21.0	15.4	36.4	1.2	15.4	9.8	25.2	0.8	12.6	7.7	20.3	0.7	12.6	7.7	20.3	0.6		

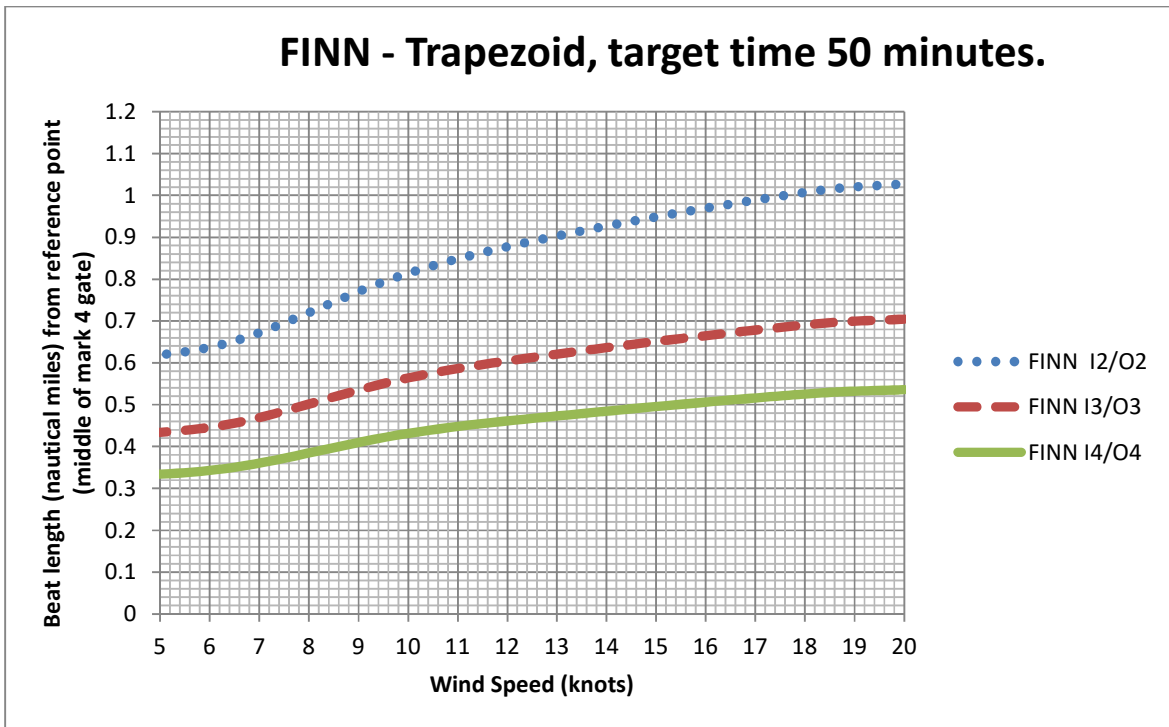
49er FX - Leeward, target time 30 minutes.



Anticipated leg times for 49er FX Leeward with race target time of 30 minutes									
Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.51		0.69		0.86		0.91	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.0	9.0	9.6	9.6	9.5	9.5	9.6	9.6
	1 to 4	6.1	15.1	5.5	15.1	5.6	15.1	5.5	15.1
	4 to 1	8.2	23.3	9.0	24.1	9.0	24.1	9.1	24.2
	1 to Finish	6.7	30.0	5.9	30.0	5.9	30.0	5.8	30.0
L3	Leg Length	0.34		0.46		0.57		0.61	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	6.2	6.2	6.6	6.6	6.5	6.5	6.6	6.6
	1 to 4	4.1	10.3	3.7	10.3	3.7	10.2	3.7	10.2
	4 to 1	5.4	15.8	6.0	16.3	6.0	16.2	6.1	16.3
	1 to 4	4.1	19.9	3.7	20.0	3.7	20.0	3.7	20.0
	4 to 1	5.4	25.3	6.0	25.9	6.0	26.0	6.1	26.1
1 to Finish	4.7	30.0	4.1	30.0	4.0	30.0	4.0	30.0	
L4	Leg Length	0.26		0.34		0.43		0.46	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	4.9	4.9	5.1	5.1	5.0	5.0	5.1	5.1
	1 to 4	3.1	8.0	2.8	7.9	2.8	7.8	2.7	7.8
	4 to 1	4.1	12.0	4.5	12.4	4.5	12.3	4.6	12.4
	1 to 4	3.1	15.1	2.8	15.1	2.8	15.1	2.7	15.1
	4 to 1	4.1	19.2	4.5	19.6	4.5	19.6	4.6	19.7
	1 to 4	3.1	22.3	2.8	22.4	2.8	22.4	2.7	22.4
	4 to 1	4.1	26.3	4.5	26.8	4.5	26.9	4.6	27.0
1 to Finish	3.7	30.0	3.2	30.0	3.1	30.0	3.0	30.0	

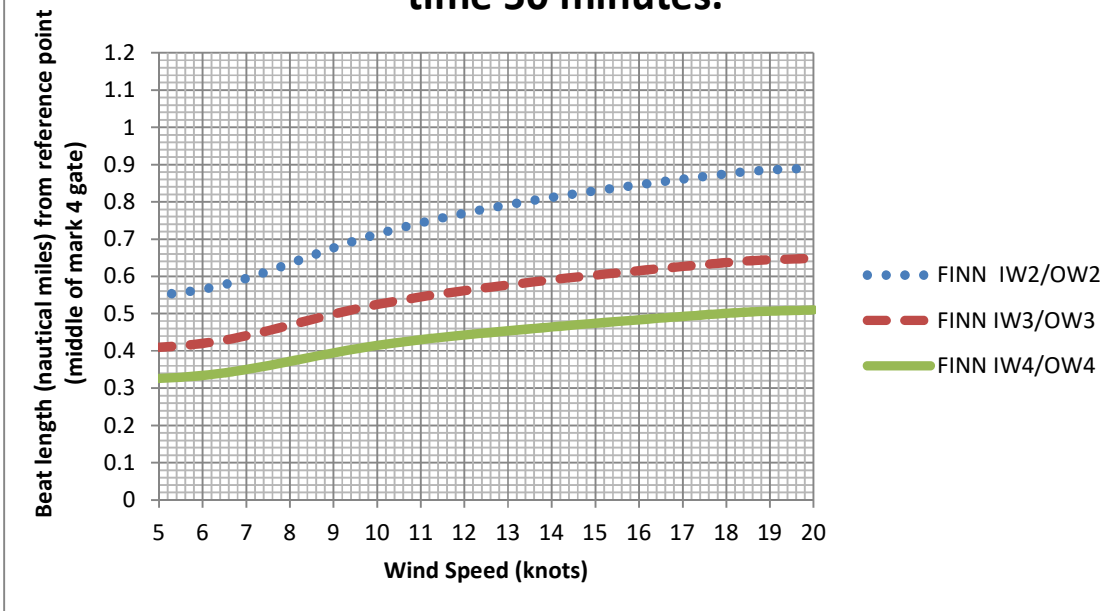
49er FX Leeward																		
Wind Range	5 - 8 Knots			8 - 12 Knots				12 - 15 Knots			15+ Knots							
Upwind speed	16 min/mile			Finish on reach leg time (LG/LR)	13 min/mile			Finish on reach leg time (LG/LR)	10.5 min/mile			Finish on reach leg time (LG/LR)	10 min/mile			Finish on reach leg time (LG/LR)		
Run Speed	12 min/mile				8 min/mile				6.5 min/mile				6 min/mile					
Reach speed	9 min/mile				6.5 min/mile				5.5 min/mile				4.5 min/mile					
Leg length Nautical Miles	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down
0.30	4.8	3.6	8.4	1.4	3.9	2.4	6.3	1.0	3.2	2.0	5.1	0.8	3.0	1.8	4.8	0.7		
0.35	5.6	4.2	9.8	1.4	4.6	2.8	7.4	1.0	3.7	2.3	6.0	0.8	3.5	2.1	5.6	0.7		
0.40	6.4	4.8	11.2	1.4	5.2	3.2	8.4	1.0	4.2	2.6	6.8	0.8	4.0	2.4	6.4	0.7		
0.45	7.2	5.4	12.6	1.4	5.9	3.6	9.5	1.0	4.7	2.9	7.7	0.8	4.5	2.7	7.2	0.7		
0.50	8.0	6.0	14.0	1.4	6.5	4.0	10.5	1.0	5.3	3.3	8.5	0.8	5.0	3.0	8.0	0.7		
0.55	8.8	6.6	15.4	1.4	7.2	4.4	11.6	1.0	5.8	3.6	9.4	0.8	5.5	3.3	8.8	0.7		
0.60	9.6	7.2	16.8	1.4	7.8	4.8	12.6	1.0	6.3	3.9	10.2	0.8	6.0	3.6	9.6	0.7		
0.65	10.4	7.8	18.2	1.4	8.5	5.2	13.7	1.0	6.8	4.2	11.1	0.8	6.5	3.9	10.4	0.7		
0.70	11.2	8.4	19.6	1.4	9.1	5.6	14.7	1.0	7.4	4.6	11.9	0.8	7.0	4.2	11.2	0.7		
0.75	12.0	9.0	21.0	1.4	9.8	6.0	15.8	1.0	7.9	4.9	12.8	0.8	7.5	4.5	12.0	0.7		
0.80	12.8	9.6	22.4	1.4	10.4	6.4	16.8	1.0	8.4	5.2	13.6	0.8	8.0	4.8	12.8	0.7		
0.85	13.6	10.2	23.8	1.4	11.1	6.8	17.9	1.0	8.9	5.5	14.5	0.8	8.5	5.1	13.6	0.7		
0.90	14.4	10.8	25.2	1.4	11.7	7.2	18.9	1.0	9.5	5.9	15.3	0.8	9.0	5.4	14.4	0.7		
0.95	15.2	11.4	26.6	1.4	12.4	7.6	20.0	1.0	10.0	6.2	16.2	0.8	9.5	5.7	15.2	0.7		
1.00	16.0	12.0	28.0	1.4	13.0	8.0	21.0	1.0	10.5	6.5	17.0	0.8	10.0	6.0	16.0	0.7		
1.05	16.8	12.6	29.4	1.4	13.7	8.4	22.1	1.0	11.0	6.8	17.9	0.8	10.5	6.3	16.8	0.7		
1.10	17.6	13.2	30.8	1.4	14.3	8.8	23.1	1.0	11.6	7.2	18.7	0.8	11.0	6.6	17.6	0.7		
1.15	18.4	13.8	32.2	1.4	15.0	9.2	24.2	1.0	12.1	7.5	19.6	0.8	11.5	6.9	18.4	0.7		
1.20	19.2	14.4	33.6	1.4	15.6	9.6	25.2	1.0	12.6	7.8	20.4	0.8	12.0	7.2	19.2	0.7		
1.25	20.0	15.0	35.0	1.4	16.3	10.0	26.3	1.0	13.1	8.1	21.3	0.8	12.5	7.5	20.0	0.7		
1.30	20.8	15.6	36.4	1.4	16.9	10.4	27.3	1.0	13.7	8.5	22.1	0.8	13.0	7.8	20.8	0.7		
1.35	21.6	16.2	37.8	1.4	17.6	10.8	28.4	1.0	14.2	8.8	23.0	0.8	13.5	8.1	21.6	0.7		
1.40	22.4	16.8	39.2	1.4	18.2	11.2	29.4	1.0	14.7	9.1	23.8	0.8	14.0	8.4	22.4	0.7		

FINN - Trapezoid, target time 50 minutes.



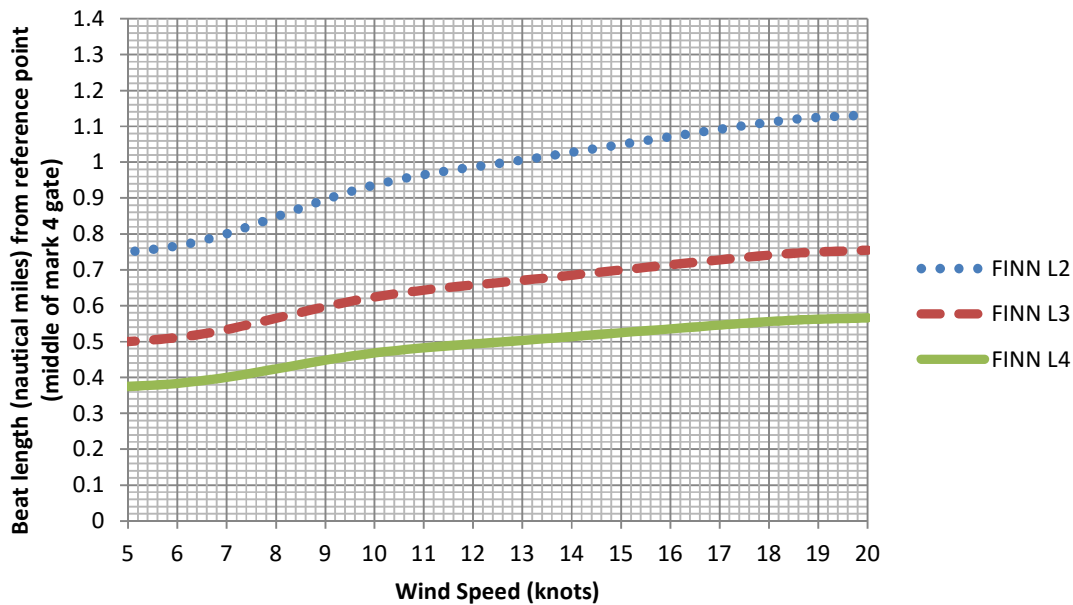
Anticipated leg times for FINN Trapezoid with a race target time 50 minutes										
Wind Range	5 - 8		8 - 12		12-15		15+			
Average beat	0.65		0.81		0.92		1.01			
12	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	02	
	Start to 1	11.2	11.2	13.0	13.0	14.5	14.5	15.9		15.9
	1 to 4	9.8	21.0	9.0	21.9	8.2	22.7	7.1		22.9
	4 to 1	10.4	31.4	12.2	34.1	13.7	36.4	15.1		38.0
	1 to 2	6.5	38.0	5.4	39.5	4.3	40.7	4.0		42.0
	2 to 3	9.8	47.8	9.0	48.5	8.2	49.0	7.1		49.1
	3 to Finish	2.3	50.0	1.5	50.0	1.1	50.0	0.9		50.0
13	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	03	
	Start to 1	8.1	8.1	9.2	9.2	10.2	10.2	11.1		11.1
	1 to 4	6.8	14.9	6.2	15.4	5.7	15.8	4.8		15.9
	4 to 1	7.3	22.2	8.5	23.9	9.4	25.3	10.4		26.3
	1 to 4	6.8	29.1	6.2	30.1	5.7	30.9	4.8		31.1
	4 to 1	7.3	36.4	8.5	38.5	9.4	40.4	10.4		41.5
	1 to 2	4.6	40.9	3.8	42.3	2.9	43.3	2.8		44.3
2 to 3	6.8	47.8	6.2	48.5	5.7	49.0	4.8	49.1		
3 to Finish	2.3	50.0	1.5	50.0	1.1	50.0	0.9	50.0		
14	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	04	
	Start to 1	6.4	6.4	7.2	7.2	7.9	7.9	8.6		8.6
	1 to 4	5.3	11.7	4.7	12.0	4.3	12.2	3.7		12.3
	4 to 1	5.6	17.3	6.5	18.4	7.2	19.4	7.9		20.2
	1 to 4	5.3	22.5	4.7	23.2	4.3	23.7	3.7		23.9
	4 to 1	5.6	28.1	6.5	29.7	7.2	30.9	7.9		31.8
	1 to 4	5.3	33.4	4.7	34.4	4.3	35.2	3.7		35.4
4 to 1	5.6	39.0	6.5	40.9	7.2	42.4	7.9	43.3		
1 to 2	3.5	42.5	2.9	43.8	2.2	44.6	2.1	45.4		
2 to 3	5.3	47.8	4.7	48.5	4.3	49.0	3.7	49.1		
3 to Finish	2.3	50.0	1.5	50.0	1.1	50.0	0.9	50.0		

FINN - Trapezoid with beat to finish, target time 50 minutes.



Anticipated leg times for FINN Trapezoid with beat to finish with a race target time 50 minutes																			
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+	
Average beat		0.57		0.70		0.79		0.86		Average beat		0.57		0.70		0.79		0.86	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total			Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
12	Start to 1	9.9	9.9	11.3	11.3	12.6	12.6	13.7	13.7	02	Start to 1	9.9	9.9	11.3	11.3	12.6	12.6	13.7	13.7
	1 to 4	8.5	18.4	7.7	19.0	7.1	19.7	6.0	19.7		1 to 2	5.7	15.6	4.7	16.0	3.7	16.3	3.5	17.1
	4 to 1	9.1	27.5	10.5	29.6	11.9	31.6	12.9	32.7		2 to 3	8.5	24.1	7.7	23.7	7.1	23.4	6.0	23.2
	1 to 2	5.7	33.2	4.7	34.3	3.7	35.3	3.5	36.1		3 to 2	9.1	33.2	10.5	34.3	11.9	35.3	12.9	36.1
	2 to 3	8.5	41.8	7.7	42.0	7.1	42.4	6.0	42.2		2 to 3	8.5	41.8	7.7	42.0	7.1	42.4	6.0	42.2
	3 to 5	5.7	47.4	4.7	46.7	3.7	46.1	3.5	45.6		3 to 5	5.7	47.4	4.7	46.7	3.7	46.1	3.5	45.6
5 to Finish		2.6	50.0	3.3	50.0	3.9	50.0	4.4	50.0	5 to Finish		2.6	50.0	3.3	50.0	3.9	50.0	4.4	50.0
Average beat		0.42		0.52		0.58		0.63		Average beat		0.42		0.52		0.58		0.63	
13	Start to 1	7.6	7.6	8.5	8.5	9.4	9.4	10.2	10.2	03	Start to 1	7.6	7.6	8.5	8.5	9.4	9.4	10.2	10.2
	1 to 4	6.3	13.9	5.7	14.2	5.2	14.6	4.4	14.6		1 to 2	4.2	11.8	3.4	12.0	2.7	12.1	2.5	12.7
	4 to 1	6.8	20.6	7.8	21.9	8.6	23.2	9.4	24.0		2 to 3	6.3	18.1	5.7	17.6	5.2	17.2	4.4	17.1
	1 to 4	6.3	27.0	5.7	27.6	5.2	28.4	4.4	28.4		3 to 2	6.8	24.9	7.8	25.4	8.6	25.9	9.4	26.5
	4 to 1	6.8	33.7	7.8	35.4	8.6	37.0	9.4	37.8		2 to 3	6.3	31.2	5.7	31.1	5.2	31.1	4.4	30.9
	1 to 2	4.2	38.0	3.4	38.8	2.7	39.7	2.5	40.3		3 to 2	6.8	38.0	7.8	38.8	8.6	39.7	9.4	40.3
2 to 3	6.3	44.3	5.7	44.5	5.2	44.9	4.4	44.7	2 to 3	6.3	44.3	5.7	44.5	5.2	44.9	4.4	44.7		
3 to 5	4.2	48.5	3.4	48.0	2.7	47.6	2.5	47.2	3 to 5	4.2	48.5	3.4	48.0	2.7	47.6	2.5	47.2		
5 to Finish		1.5	50.0	2.0	50.0	2.4	50.0	2.8	50.0	5 to Finish		1.5	50.0	2.0	50.0	2.4	50.0	2.8	50.0
Average beat		0.34		0.41		0.45		0.49		Average beat		0.34		0.41		0.45		0.49	
14	Start to 1	6.2	6.2	6.9	6.9	7.5	7.5	8.2	8.2	04	Start to 1	6.2	6.2	6.9	6.9	7.5	7.5	8.2	8.2
	1 to 4	5.0	11.2	4.5	11.4	4.1	11.6	3.5	11.6		1 to 2	3.4	9.5	2.7	9.6	2.1	9.6	2.0	10.1
	4 to 1	5.4	16.6	6.1	17.5	6.8	18.4	7.4	19.0		2 to 3	5.0	14.6	4.5	14.1	4.1	13.7	3.5	13.6
	1 to 4	5.0	21.6	4.5	22.0	4.1	22.5	3.5	22.5		3 to 2	5.4	19.9	6.1	20.2	6.8	20.5	7.4	21.0
	4 to 1	5.4	27.0	6.1	28.1	6.8	29.3	7.4	29.9		2 to 3	5.0	25.0	4.5	24.7	4.1	24.6	3.5	24.4
	1 to 4	5.0	32.0	4.5	32.6	4.1	33.3	3.5	33.3		3 to 2	5.4	30.3	6.1	30.9	6.8	31.4	7.4	31.8
4 to 1	5.4	37.4	6.1	38.8	6.8	40.1	7.4	40.7	2 to 3	5.0	35.4	4.5	35.4	4.1	35.4	3.5	35.3		
1 to 2	3.4	40.8	2.7	41.5	2.1	42.2	2.0	42.7	3 to 2	5.4	40.8	6.1	41.5	6.8	42.2	7.4	42.7		
2 to 3	5.0	45.8	4.5	46.0	4.1	46.3	3.5	46.2	2 to 3	5.0	45.8	4.5	46.0	4.1	46.3	3.5	46.2		
3 to 5	3.4	49.2	2.7	48.7	2.1	48.4	2.0	48.1	3 to 5	3.4	49.2	2.7	48.7	2.1	48.4	2.0	48.1		
5 to Finish		0.8	50.0	1.3	50.0	1.6	50.0	1.9	50.0	5 to Finish		0.8	50.0	1.3	50.0	1.6	50.0	1.9	50.0

FINN - Leeward, target time 50 minutes.

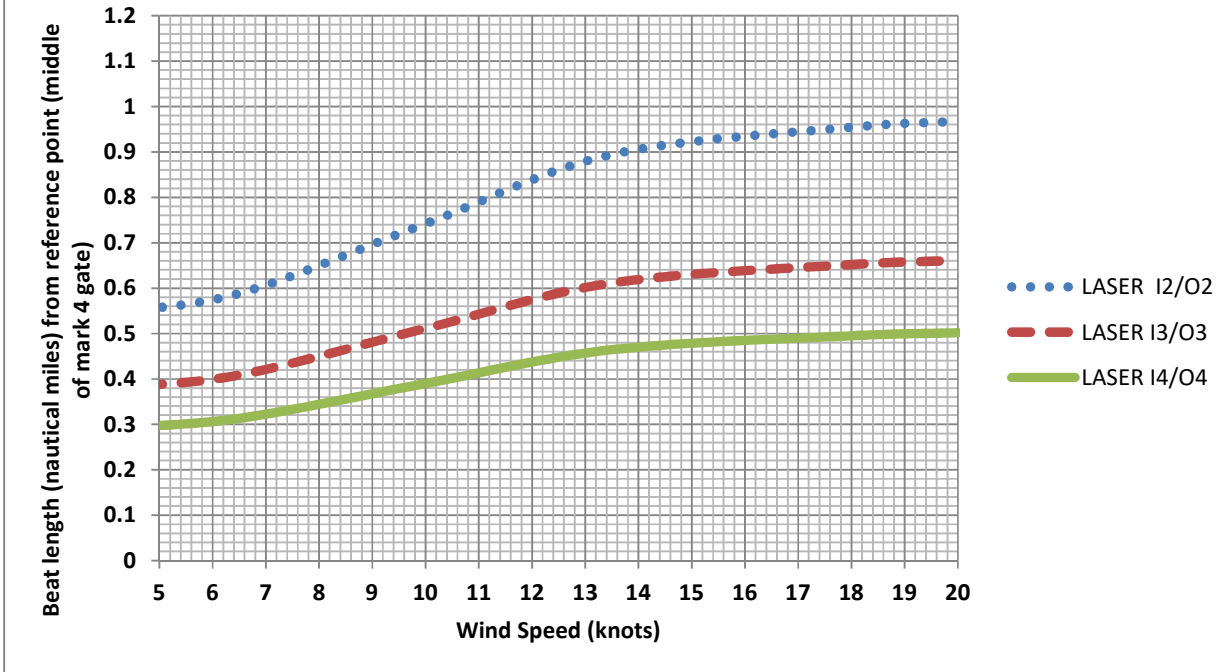


Anticipated leg times for FINN Leeward with race target time of 50 minutes									
Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.78		0.94		1.02		1.11	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	13.3	13.3	14.8	14.8	16.0	16.0	17.4	17.4
	1 to 4	11.7	25.0	10.3	25.1	9.2	25.2	7.8	25.2
	4 to 1	12.5	37.5	14.0	39.1	15.3	40.4	16.7	41.9
1 to Finish	12.5	50.0	10.9	50.0	9.6	50.0	8.1	50.0	
L3	Leg Length	0.52		0.62		0.68		0.74	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.1	9.1	10.1	10.1	10.9	10.9	11.9	11.9
	1 to 4	7.8	17.0	6.9	17.0	6.1	17.0	5.2	17.1
	4 to 1	8.3	25.3	9.4	26.3	10.2	27.2	11.1	28.2
	1 to 4	7.8	33.1	6.9	33.2	6.1	33.3	5.2	33.4
	4 to 1	8.3	41.4	9.4	42.6	10.2	43.5	11.1	44.5
1 to Finish	8.6	50.0	7.4	50.0	6.6	50.0	5.5	50.0	
L4	Leg Length	0.39		0.47		0.51		0.56	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	7.1	7.1	7.8	7.8	8.4	8.4	9.1	9.1
	1 to 4	5.9	12.9	5.2	12.9	4.6	13.0	3.9	13.0
	4 to 1	6.3	19.2	7.0	19.9	7.6	20.6	8.3	21.3
	1 to 4	5.9	25.0	5.2	25.1	4.6	25.2	3.9	25.2
	4 to 1	6.3	31.3	7.0	32.1	7.6	32.8	8.3	33.5
	1 to 4	5.9	37.1	5.2	37.3	4.6	37.4	3.9	37.4
4 to 1	6.3	43.4	7.0	44.3	7.6	45.0	8.3	45.8	
1 to Finish	6.6	50.0	5.7	50.0	5.0	50.0	4.2	50.0	

FINN 70° 110° Trapezoid with beat to finish (finish 0.05 below the starting line)																				
Wind Range	5 - 8 Knots					8 - 12 Knots					12 - 15 Knots					15+ Knots				
Upwind speed	16 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	15 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	15 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	15 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)
Run Speed	15 min/mile					11 min/mile					9 min/mile					7 min/mile				
Reach speed	15 min/mile					10 min/mile					7 min/mile					6 min/mile				
Beat length Nautical Miles (Ref to 1)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)
0.30	4.8	4.5	9.3	3.0	0.6	4.5	3.3	7.8	2.0	0.4	4.5	2.7	7.2	1.4	0.3	4.5	2.1	6.6	1.2	0.2
0.35	5.6	5.3	10.9	3.5	0.9	5.3	3.9	9.1	2.3	0.6	5.3	3.2	8.4	1.6	0.4	5.3	2.5	7.7	1.4	0.4
0.40	6.4	6.0	12.4	4.0	1.2	6.0	4.4	10.4	2.7	0.8	6.0	3.6	9.6	1.9	0.6	6.0	2.8	8.8	1.6	0.5
0.45	7.2	6.8	14.0	4.5	1.6	6.8	5.0	11.7	3.0	1.1	6.8	4.1	10.8	2.1	0.7	6.8	3.2	9.9	1.8	0.6
0.50	8.0	7.5	15.5	5.0	1.9	7.5	5.5	13.0	3.3	1.3	7.5	4.5	12.0	2.3	0.9	7.5	3.5	11.0	2.0	0.8
0.55	8.8	8.3	17.1	5.5	2.3	8.3	6.1	14.3	3.7	1.5	8.3	5.0	13.2	2.6	1.1	8.3	3.9	12.1	2.2	0.9
0.60	9.6	9.0	18.6	6.0	2.6	9.0	6.6	15.6	4.0	1.7	9.0	5.4	14.4	2.8	1.2	9.0	4.2	13.2	2.4	1.0
0.65	10.4	9.8	20.2	6.5	2.9	9.8	7.2	16.9	4.3	2.0	9.8	5.9	15.6	3.0	1.4	9.8	4.6	14.3	2.6	1.2
0.70	11.2	10.5	21.7	7.0	3.3	10.5	7.7	18.2	4.7	2.2	10.5	6.3	16.8	3.3	1.5	10.5	4.9	15.4	2.8	1.3
0.75	12.0	11.3	23.3	7.5	3.6	11.3	8.3	19.5	5.0	2.4	11.3	6.8	18.0	3.5	1.7	11.3	5.3	16.5	3.0	1.5
0.80	12.8	12.0	24.8	8.0	4.0	12.0	8.8	20.8	5.3	2.6	12.0	7.2	19.2	3.7	1.9	12.0	5.6	17.6	3.2	1.6
0.85	13.6	12.8	26.4	8.5	4.3	12.8	9.4	22.1	5.7	2.9	12.8	7.7	20.4	4.0	2.0	12.8	6.0	18.7	3.4	1.7
0.90	14.4	13.5	27.9	9.0	4.7	13.5	9.9	23.4	6.0	3.1	13.5	8.1	21.6	4.2	2.2	13.5	6.3	19.8	3.6	1.9
0.95	15.2	14.3	29.5	9.5	5.0	14.3	10.5	24.7	6.3	3.3	14.3	8.6	22.8	4.4	2.3	14.3	6.7	20.9	3.8	2.0
1.00	16.0	15.0	31.0	10.0	5.3	15.0	11.0	26.0	6.7	3.6	15.0	9.0	24.0	4.7	2.5	15.0	7.0	22.0	4.0	2.1
1.05	16.8	15.8	32.6	10.5	5.7	15.8	11.6	27.3	7.0	3.8	15.8	9.5	25.2	4.9	2.7	15.8	7.4	23.1	4.2	2.3
1.10	17.6	16.5	34.1	11.0	6.0	16.5	12.1	28.6	7.3	4.0	16.5	9.9	26.4	5.1	2.8	16.5	7.7	24.2	4.4	2.4
1.15	18.4	17.3	35.7	11.5	6.4	17.3	12.7	29.9	7.7	4.2	17.3	10.4	27.6	5.4	3.0	17.3	8.1	25.3	4.6	2.5
1.20	19.2	18.0	37.2	12.0	6.7	18.0	13.2	31.2	8.0	4.5	18.0	10.8	28.8	5.6	3.1	18.0	8.4	26.4	4.8	2.7
1.25	20.0	18.8	38.8	12.5	7.1	18.8	13.8	32.5	8.3	4.7	18.8	11.3	30.0	5.8	3.3	18.8	8.8	27.5	5.0	2.8
1.30	20.8	19.5	40.3	13.0	7.4	19.5	14.3	33.8	8.7	4.9	19.5	11.7	31.2	6.1	3.4	19.5	9.1	28.6	5.2	3.0
1.35	21.6	20.3	41.9	13.5	7.7	20.3	14.9	35.1	9.0	5.2	20.3	12.2	32.4	6.3	3.6	20.3	9.5	29.7	5.4	3.1
1.40	22.4	21.0	43.4	14.0	8.1	21.0	15.4	36.4	9.3	5.4	21.0	12.6	33.6	6.5	3.8	21.0	9.8	30.8	5.6	3.2

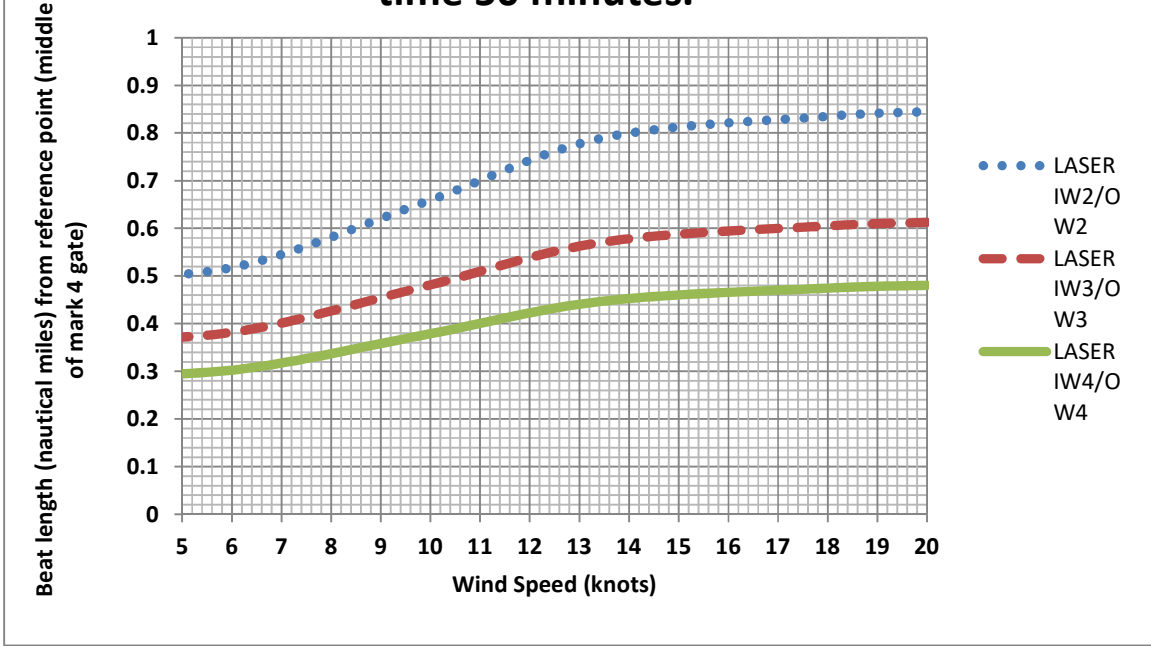
Time from Start to Reference (0.05NM) and Reference to Finish (0.05 NM (Downwind finish))											
0.05	0.8	0.8		0.8	0.6		0.8	0.5		0.8	0.4
Time for reaching leg from gate to finish of 0.15 NM											
0.15			2.25			1.5			1.05		0.9

LASER - Trapezoid, target time 50 minutes.



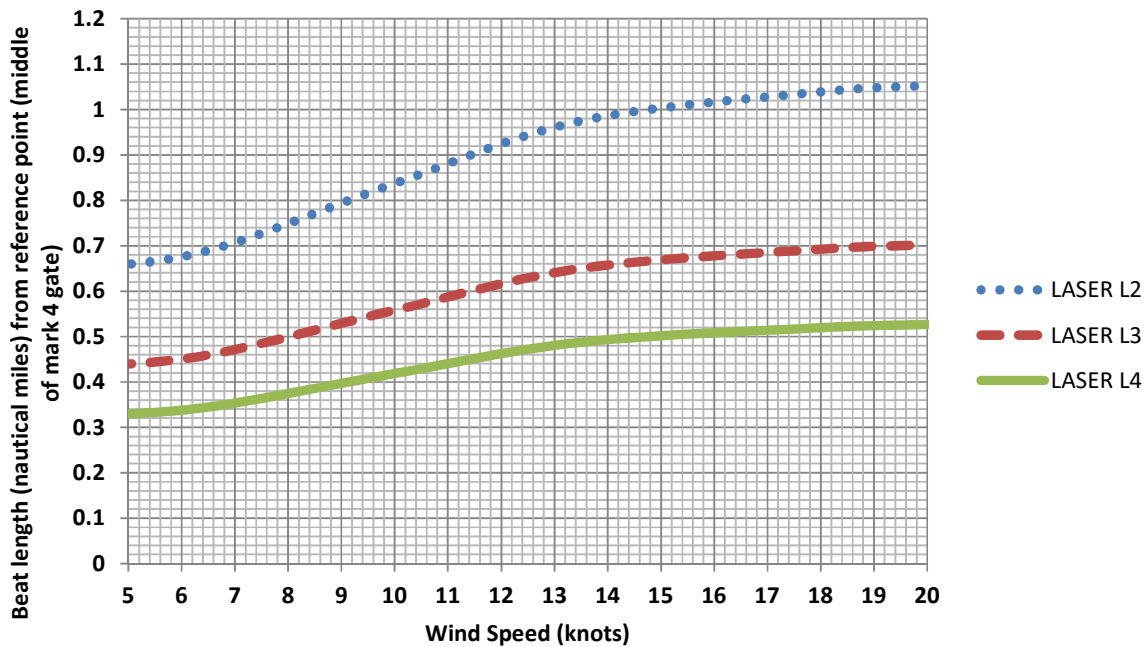
Anticipated leg times for LASER Trapezoid with a race target time 50 minutes																			
Wind Range	5 - 8		8 - 12		12-15		15+		Wind Range	5 - 8		8 - 12		12-15		15+			
Average beat	0.59		0.74		0.89		0.95		Average beat	0.59		0.74		0.89		0.95			
12		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	02		Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	12.1	12.1	13.5	13.5	15.1	15.1	16.6	16.6		Start to 1	12.1	12.1	13.5	13.5	15.1	15.1	16.6	16.6
	1 to 4	9.4	21.5	8.9	22.4	8.1	23.2	6.7	23.3		1 to 2	5.7	17.8	4.7	18.2	3.6	18.7	3.5	20.1
	4 to 1	11.2	32.7	12.6	35.0	14.3	37.5	15.7	39.0		2 to 3	9.4	27.2	8.9	27.1	8.1	26.7	6.7	26.7
	1 to 2	5.7	38.4	4.7	39.7	3.6	41.1	3.5	42.5		3 to 2	11.2	38.4	12.6	39.7	14.3	41.1	15.7	42.5
	2 to 3	9.4	47.8	8.9	48.6	8.1	49.1	6.7	49.2		2 to 3	9.4	47.8	8.9	48.6	8.1	49.1	6.7	49.2
	3 to Finish	2.2	50.0	1.4	50.0	0.9	50.0	0.8	50.0		3 to Finish	2.2	50.0	1.4	50.0	0.9	50.0	0.8	50.0
	Average beat	0.59		0.74		0.89		0.95			Average beat	0.59		0.74		0.89		0.95	
13		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	03		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	8.7	8.7	9.5	9.5	10.6	10.6	11.6	11.6		Start to 1	8.7	8.7	9.5	9.5	10.6	10.6	11.6	11.6
	1 to 4	6.5	15.3	6.1	15.7	5.5	16.1	4.6	16.1		1 to 2	4.0	12.7	3.2	12.8	2.4	13.0	2.4	14.0
	4 to 1	7.8	23.0	8.7	24.4	9.8	25.9	10.8	26.9		2 to 3	6.5	19.2	6.1	18.9	5.5	18.5	4.6	18.5
	1 to 4	6.5	29.6	6.1	30.5	5.5	31.4	4.6	31.5		3 to 2	7.8	27.0	8.7	27.6	9.8	28.3	10.8	29.3
	4 to 1	7.8	37.3	8.7	39.2	9.8	41.2	10.8	42.2		2 to 3	6.5	33.5	6.1	33.7	5.5	33.8	4.6	33.9
	1 to 2	4.0	41.3	3.2	42.4	2.4	43.6	2.4	44.6		3 to 2	7.8	41.3	8.7	42.4	9.8	43.6	10.8	44.6
	2 to 3	6.5	47.8	6.1	48.6	5.5	49.1	4.6	49.2		2 to 3	6.5	47.8	6.1	48.6	5.5	49.1	4.6	49.2
3 to Finish	2.2	50.0	1.4	50.0	0.9	50.0	0.8	50.0	3 to Finish	2.2	50.0	1.4	50.0	0.9	50.0	0.8	50.0		
Average beat	0.41		0.51		0.61		0.65		Average beat	0.41		0.51		0.61		0.65			
14		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	04		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	6.9	6.9	7.5	7.5	8.2	8.2	9.0	9.0		Start to 1	6.9	6.9	7.5	7.5	8.2	8.2	9.0	9.0
	1 to 4	5.0	11.9	4.7	12.2	4.2	12.4	3.5	12.5		1 to 2	3.0	9.9	2.5	10.0	1.9	10.1	1.8	10.8
	4 to 1	6.0	17.9	6.6	18.8	7.4	19.8	8.2	20.6		2 to 3	5.0	14.9	4.7	14.6	4.2	14.3	3.5	14.3
	1 to 4	5.0	22.9	4.7	23.5	4.2	24.0	3.5	24.1		3 to 2	6.0	20.9	6.6	21.3	7.4	21.7	8.2	22.4
	4 to 1	6.0	28.8	6.6	30.1	7.4	31.5	8.2	32.3		2 to 3	5.0	25.9	4.7	25.9	4.2	25.9	3.5	25.9
	1 to 4	5.0	33.8	4.7	34.8	4.2	35.6	3.5	35.7		3 to 2	6.0	31.9	6.6	32.6	7.4	33.3	8.2	34.1
	4 to 1	6.0	39.8	6.6	41.4	7.4	43.1	8.2	43.9		2 to 3	5.0	36.9	4.7	37.3	4.2	37.5	3.5	37.5
1 to 2	3.0	42.8	2.5	43.9	1.9	44.9	1.8	45.7	3 to 2	6.0	42.8	6.6	43.9	7.4	44.9	8.2	45.7		
2 to 3	5.0	47.8	4.7	48.6	4.2	49.1	3.5	49.2	2 to 3	5.0	47.8	4.7	48.6	4.2	49.1	3.5	49.2		
3 to Finish	2.2	50.0	1.4	50.0	0.9	50.0	0.8	50.0	3 to Finish	2.2	50.0	1.4	50.0	0.9	50.0	0.8	50.0		
Average beat	0.31		0.39		0.46		0.50		Average beat	0.31		0.39		0.46		0.50			

LASER - Trapezoid with beat to finish, target time 50 minutes.



Anticipated leg times for LASER Trapezoid with beat to finish with a race target time 50 minutes																			
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+	
Average beat		0.52		0.65		0.78		0.82		Average beat		0.52		0.65		0.78		0.82	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total			Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
12	Start to 1	10.8	10.8	11.9	11.9	13.2	13.2	14.4	14.4	02	Start to 1	10.8	10.8	11.9	11.9	13.2	13.2	14.4	14.4
	1 to 4	8.3	19.1	7.8	19.7	7.0	20.2	5.8	20.1		1 to 2	5.0	15.9	4.1	16.0	3.1	16.4	3.0	17.4
	4 to 1	9.9	29.0	11.0	30.7	12.4	32.7	13.6	33.7		2 to 3	8.3	24.2	7.8	23.8	7.0	23.4	5.8	23.1
	1 to 2	5.0	34.1	4.1	34.8	3.1	35.8	3.0	36.7		3 to 2	9.9	34.1	11.0	34.8	12.4	35.8	13.6	36.7
	2 to 3	8.3	42.4	7.8	42.6	7.0	42.8	5.8	42.5		2 to 3	8.3	42.4	7.8	42.6	7.0	42.8	5.8	42.5
	3 to 5	5.0	47.4	4.1	46.7	3.1	45.9	3.0	45.5		3 to 5	5.0	47.4	4.1	46.7	3.1	45.9	3.0	45.5
	5 to Finish	2.6	50.0	3.3	50.0	4.1	50.0	4.5	50.0		5 to Finish	2.6	50.0	3.3	50.0	4.1	50.0	4.5	50.0
Average beat		0.38		0.47		0.56		0.60		Average beat		0.38		0.47		0.56		0.60	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total			Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
13	Start to 1	8.2	8.2	8.9	8.9	9.8	9.8	10.6	10.6	03	Start to 1	8.2	8.2	8.9	8.9	9.8	9.8	10.6	10.6
	1 to 4	6.1	14.4	5.7	14.6	5.1	14.9	4.2	14.8		1 to 2	3.7	11.9	3.0	11.9	2.3	12.1	2.2	12.8
	4 to 1	7.3	21.6	8.0	22.6	9.0	23.9	9.8	24.6		2 to 3	6.1	18.1	5.7	17.6	5.1	17.1	4.2	17.0
	1 to 4	6.1	27.8	5.7	28.3	5.1	28.9	4.2	28.8		3 to 2	7.3	25.3	8.0	25.6	9.0	26.1	9.8	26.8
	4 to 1	7.3	35.0	8.0	36.4	9.0	37.9	9.8	38.6		2 to 3	6.1	31.5	5.7	31.3	5.1	31.2	4.2	31.0
	1 to 2	3.7	38.7	3.0	39.4	2.3	40.2	2.2	40.8		3 to 2	7.3	38.7	8.0	39.4	9.0	40.2	9.8	40.8
	2 to 3	6.1	44.9	5.7	45.0	5.1	45.2	4.2	45.0		2 to 3	6.1	44.9	5.7	45.0	5.1	45.2	4.2	45.0
3 to 5	3.7	48.6	3.0	48.0	2.3	47.5	2.2	47.2	3 to 5	3.7	48.6	3.0	48.0	2.3	47.5	2.2	47.2		
5 to Finish	1.4	50.0	2.0	50.0	2.5	50.0	2.8	50.0	5 to Finish	1.4	50.0	2.0	50.0	2.5	50.0	2.8	50.0		
Average beat		0.30		0.37		0.44		0.47		Average beat		0.30		0.37		0.44		0.47	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total			Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
14	Start to 1	6.7	6.7	7.2	7.2	7.8	7.8	8.5	8.5	04	Start to 1	6.7	6.7	7.2	7.2	7.8	7.8	8.5	8.5
	1 to 4	4.9	11.6	4.5	11.7	4.0	11.8	3.3	11.8		1 to 2	2.9	9.6	2.4	9.5	1.8	9.6	1.7	10.2
	4 to 1	5.8	17.3	6.3	18.0	7.0	18.9	7.7	19.5		2 to 3	4.9	14.5	4.5	14.0	4.0	13.6	3.3	13.5
	1 to 4	4.9	22.2	4.5	22.5	4.0	22.8	3.3	22.8		3 to 2	5.8	20.3	6.3	20.4	7.0	20.6	7.7	21.2
	4 to 1	5.8	27.9	6.3	28.8	7.0	29.9	7.7	30.5		2 to 3	4.9	25.1	4.5	24.8	4.0	24.6	3.3	24.5
	1 to 4	4.9	32.8	4.5	33.3	4.0	33.8	3.3	33.7		3 to 2	5.8	30.9	6.3	31.2	7.0	31.6	7.7	32.2
	4 to 1	5.8	38.6	6.3	39.6	7.0	40.9	7.7	41.4		2 to 3	4.9	35.7	4.5	35.6	4.0	35.6	3.3	35.5
1 to 2	2.9	41.5	2.4	42.0	1.8	42.7	1.7	43.2	3 to 2	5.8	41.5	6.3	42.0	7.0	42.7	7.7	43.2		
2 to 3	4.9	46.3	4.5	46.4	4.0	46.6	3.3	46.4	2 to 3	4.9	46.3	4.5	46.4	4.0	46.6	3.3	46.4		
3 to 5	2.9	49.3	2.4	48.8	1.8	48.4	1.7	48.1	3 to 5	2.9	49.3	2.4	48.8	1.8	48.4	1.7	48.1		
5 to Finish	0.7	50.0	1.2	50.0	1.6	50.0	1.9	50.0	5 to Finish	0.7	50.0	1.2	50.0	1.6	50.0	1.9	50.0		

LASER - Leeward, target time 50 minutes.

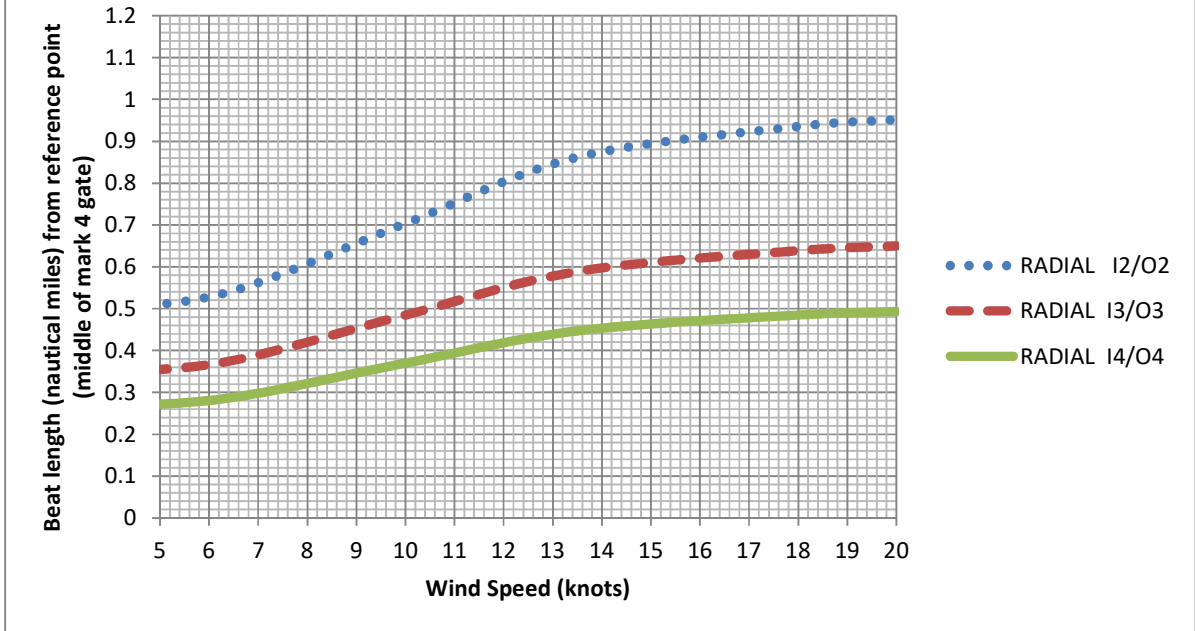


Anticipated leg times for LASER Leeward with race target time of 50 minutes									
Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.69		0.84		0.98		1.04	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	14.0	14.0	15.1	15.1	16.4	16.4	18.0	18.0
	1 to 4	11.0	25.1	10.0	25.1	8.8	25.2	7.3	25.2
	4 to 1	13.1	38.2	14.2	39.4	15.6	40.8	17.1	42.4
	1 to Finish	11.8	50.0	10.6	50.0	9.2	50.0	7.6	50.0
L3	Leg Length	0.46		0.56		0.65		0.69	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.7	9.7	10.3	10.3	11.2	11.2	12.3	12.3
	1 to 4	7.4	17.0	6.7	17.0	5.9	17.1	4.8	17.1
	4 to 1	8.7	25.8	9.5	26.5	10.4	27.5	11.4	28.5
	1 to 4	7.4	33.1	6.7	33.2	5.9	33.3	4.8	33.4
	4 to 1	8.7	41.8	9.5	42.7	10.4	43.7	11.4	44.8
1 to Finish	8.2	50.0	7.3	50.0	6.3	50.0	5.2	50.0	
L4	Leg Length	0.34		0.42		0.49		0.52	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	7.5	7.5	8.0	8.0	8.6	8.6	9.4	9.4
	1 to 4	5.5	13.0	5.0	13.0	4.4	13.0	3.6	13.0
	4 to 1	6.5	19.6	7.1	20.1	7.8	20.8	8.6	21.6
	1 to 4	5.5	25.1	5.0	25.1	4.4	25.2	3.6	25.2
	4 to 1	6.5	31.6	7.1	32.2	7.8	33.0	8.6	33.8
	1 to 4	5.5	37.1	5.0	37.3	4.4	37.4	3.6	37.4
	4 to 1	6.5	43.7	7.1	44.4	7.8	45.2	8.6	46.0
1 to Finish	6.3	50.0	5.6	50.0	4.8	50.0	4.0	50.0	

LASER 70° 110° Trapezoid with beat to finish (finish 0.05 below the starting line)																					
Wind Range	5 - 8 Knots					8 - 12 Knots					12 - 15 Knots					15+ Knots					
Upwind speed	19 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	17 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	16 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	16.5 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	
Run Speed	16 min/mile					12 min/mile					9 min/mile					7 min/mile					
Reach speed	14.5 min/mile					9.5 min/mile					6 min/mile					5.5 min/mile					
Beat length Nautical Miles (Ref to 1)	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down
0.30	5.7	4.8	10.5	2.9	0.5	5.1	3.6	8.7	1.9	0.3	4.8	2.7	7.5	1.2	0.2	5.0	2.1	7.1	1.1	0.2	
0.35	6.7	5.6	12.3	3.4	0.9	6.0	4.2	10.2	2.2	0.6	5.6	3.2	8.8	1.4	0.4	5.8	2.5	8.2	1.3	0.3	
0.40	7.6	6.4	14.0	3.9	1.2	6.8	4.8	11.6	2.5	0.8	6.4	3.6	10.0	1.6	0.5	6.6	2.8	9.4	1.5	0.5	
0.45	8.6	7.2	15.8	4.4	1.5	7.7	5.4	13.1	2.9	1.0	7.2	4.1	11.3	1.8	0.6	7.4	3.2	10.6	1.7	0.6	
0.50	9.5	8.0	17.5	4.8	1.9	8.5	6.0	14.5	3.2	1.2	8.0	4.5	12.5	2.0	0.8	8.3	3.5	11.8	1.8	0.7	
0.55	10.5	8.8	19.3	5.3	2.2	9.4	6.6	16.0	3.5	1.4	8.8	5.0	13.8	2.2	0.9	9.1	3.9	12.9	2.0	0.8	
0.60	11.4	9.6	21.0	5.8	2.5	10.2	7.2	17.4	3.8	1.6	9.6	5.4	15.0	2.4	1.0	9.9	4.2	14.1	2.2	1.0	
0.65	12.4	10.4	22.8	6.3	2.8	11.1	7.8	18.9	4.1	1.9	10.4	5.9	16.3	2.6	1.2	10.7	4.6	15.3	2.4	1.1	
0.70	13.3	11.2	24.5	6.8	3.2	11.9	8.4	20.3	4.4	2.1	11.2	6.3	17.5	2.8	1.3	11.6	4.9	16.5	2.6	1.2	
0.75	14.3	12.0	26.3	7.3	3.5	12.8	9.0	21.8	4.8	2.3	12.0	6.8	18.8	3.0	1.5	12.4	5.3	17.6	2.8	1.3	
0.80	15.2	12.8	28.0	7.7	3.8	13.6	9.6	23.2	5.1	2.5	12.8	7.2	20.0	3.2	1.6	13.2	5.6	18.8	2.9	1.5	
0.85	16.2	13.6	29.8	8.2	4.2	14.5	10.2	24.7	5.4	2.7	13.6	7.7	21.3	3.4	1.7	14.0	6.0	20.0	3.1	1.6	
0.90	17.1	14.4	31.5	8.7	4.5	15.3	10.8	26.1	5.7	2.9	14.4	8.1	22.5	3.6	1.9	14.9	6.3	21.2	3.3	1.7	
0.95	18.1	15.2	33.3	9.2	4.8	16.2	11.4	27.6	6.0	3.2	15.2	8.6	23.8	3.8	2.0	15.7	6.7	22.3	3.5	1.8	
1.00	19.0	16.0	35.0	9.7	5.2	17.0	12.0	29.0	6.3	3.4	16.0	9.0	25.0	4.0	2.1	16.5	7.0	23.5	3.7	2.0	
1.05	20.0	16.8	36.8	10.2	5.5	17.9	12.6	30.5	6.7	3.6	16.8	9.5	26.3	4.2	2.3	17.3	7.4	24.7	3.9	2.1	
1.10	20.9	17.6	38.5	10.6	5.8	18.7	13.2	31.9	7.0	3.8	17.6	9.9	27.5	4.4	2.4	18.2	7.7	25.9	4.0	2.2	
1.15	21.9	18.4	40.3	11.1	6.2	19.6	13.8	33.4	7.3	4.0	18.4	10.4	28.8	4.6	2.5	19.0	8.1	27.0	4.2	2.3	
1.20	22.8	19.2	42.0	11.6	6.5	20.4	14.4	34.8	7.6	4.2	19.2	10.8	30.0	4.8	2.7	19.8	8.4	28.2	4.4	2.5	
1.25	23.8	20.0	43.8	12.1	6.8	21.3	15.0	36.3	7.9	4.5	20.0	11.3	31.3	5.0	2.8	20.6	8.8	29.4	4.6	2.6	
1.30	24.7	20.8	45.5	12.6	7.1	22.1	15.6	37.7	8.2	4.7	20.8	11.7	32.5	5.2	3.0	21.5	9.1	30.6	4.8	2.7	
1.35	25.7	21.6	47.3	13.1	7.5	23.0	16.2	39.2	8.6	4.9	21.6	12.2	33.8	5.4	3.1	22.3	9.5	31.7	5.0	2.8	
1.40	26.6	22.4	49.0	13.5	7.8	23.8	16.8	40.6	8.9	5.1	22.4	12.6	35.0	5.6	3.2	23.1	9.8	32.9	5.1	3.0	

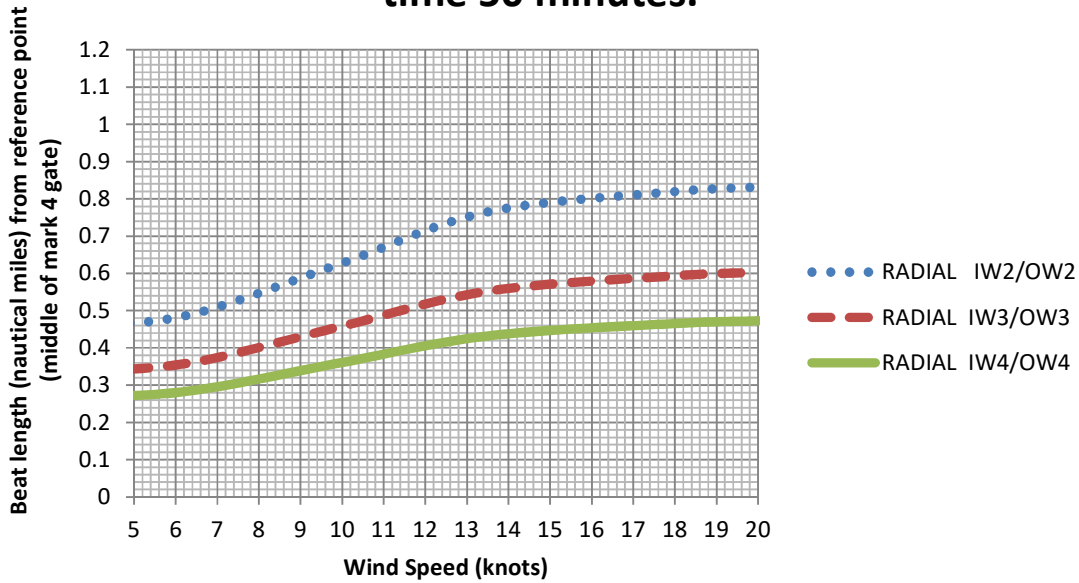
Time from Start to Reference (0.05NM) and Reference to Finish (0.05 NM (Downwind finish))											
0.05	1.0	0.8		0.9	0.6		0.8	0.5		0.8	0.4
Time for reaching leg from gate to finish of 0.15 NM											
0.15			2.18			1.43			0.9		0.8

RADIAL - Trapezoid, target time 50 minutes.



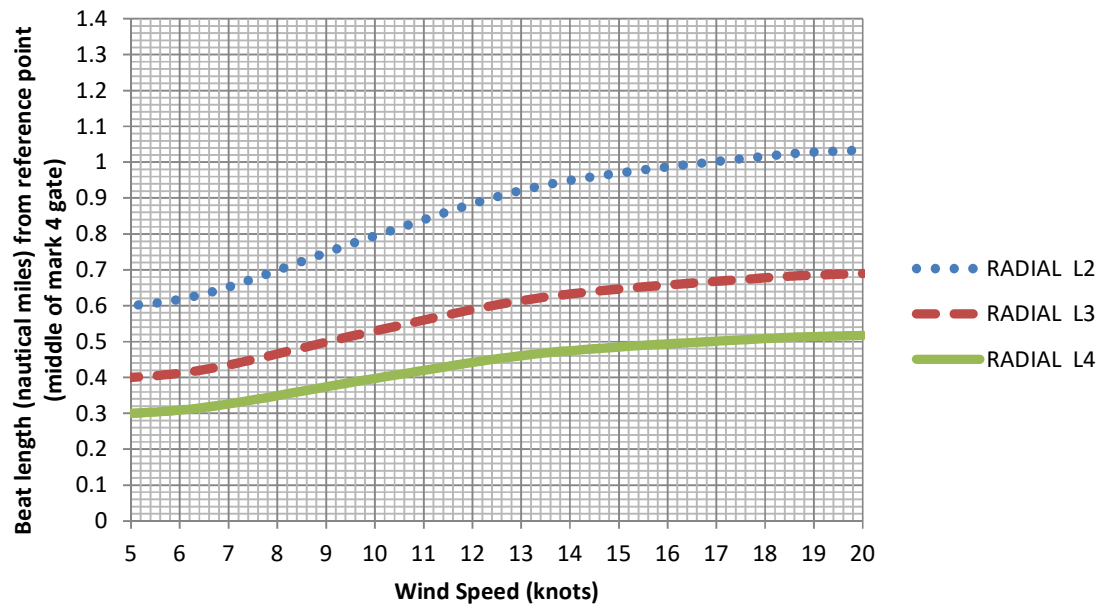
Anticipated leg times for RADIAL Trapezoid with a race target time 50 minutes										
Wind Range	5 - 8		8 - 12		12-15		15+			
Average beat	0.54		0.70		0.86		0.94			
12	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	02	
	Start to 1	12.5	12.5	13.6	13.6	15.0	15.0	16.8		16.8
	1 to 4	9.2	21.7	8.8	22.4	8.2	23.2	6.5		23.3
	4 to 1	11.4	33.1	12.7	35.0	14.2	37.5	15.9		39.2
	1 to 2	5.4	38.5	4.7	39.7	3.4	40.9	3.4		42.6
	2 to 3	9.2	47.8	8.8	48.5	8.2	49.1	6.5		49.2
	3 to Finish	2.3	50.0	1.5	50.0	0.9	50.0	0.8		50.0
13	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	03	
	Start to 1	9.0	9.0	9.6	9.6	10.5	10.5	11.7		11.7
	1 to 4	6.4	15.4	6.1	15.7	5.6	16.1	4.5		16.2
	4 to 1	7.9	23.3	8.7	24.4	9.7	25.8	10.9		27.0
	1 to 4	6.4	29.7	6.1	30.5	5.6	31.4	4.5		31.5
	4 to 1	7.9	37.6	8.7	39.2	9.7	41.2	10.9		42.4
	1 to 2	3.8	41.3	3.2	42.4	2.4	43.5	2.3		44.7
2 to 3	6.4	47.8	6.1	48.5	5.6	49.1	4.5	49.2		
3 to Finish	2.3	50.0	1.5	50.0	0.9	50.0	0.8	50.0		
14	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	04	
	Start to 1	7.1	7.1	7.6	7.6	8.2	8.2	9.1		9.1
	1 to 4	4.9	12.0	4.6	12.2	4.2	12.4	3.4		12.5
	4 to 1	6.1	18.1	6.7	18.8	7.4	19.8	8.2		20.7
	1 to 4	4.9	23.0	4.6	23.5	4.2	24.1	3.4		24.1
	4 to 1	6.1	29.0	6.7	30.1	7.4	31.4	8.2		32.4
	1 to 4	4.9	33.9	4.6	34.8	4.2	35.7	3.4		35.8
4 to 1	6.1	40.0	6.7	41.4	7.4	43.1	8.2	44.0		
1 to 2	2.9	42.8	2.5	43.9	1.8	44.9	1.8	45.8		
2 to 3	4.9	47.8	4.6	48.5	4.2	49.1	3.4	49.2		
3 to Finish	2.3	50.0	1.5	50.0	0.9	50.0	0.8	50.0		

RADIAL - Trapezoid with beat to finish, target time 50 minutes.



Anticipated leg times for RADIAL Trapezoid with beat to finish with a race target time 50 minutes																			
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+	
Average beat	0.48		0.62		0.75		0.81		Average beat	0.48		0.62		0.75		0.81			
	Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
12	Start to 1	11.2	11.2	12.0	12.0	13.2	13.2	14.6	14.6	02	Start to 1	11.2	11.2	12.0	12.0	13.2	13.2	14.6	14.6
	1 to 4	8.2	19.4	7.7	19.7	7.2	20.4	5.6	20.2		1 to 2	4.8	16.0	4.1	16.1	3.0	16.3	3.0	17.5
	4 to 1	10.2	29.6	11.1	30.8	12.4	32.8	13.7	33.9		2 to 3	8.2	24.3	7.7	23.8	7.2	23.4	5.6	23.2
	1 to 2	4.8	34.4	4.1	34.9	3.0	35.8	3.0	36.9		3 to 2	10.2	34.4	11.1	34.9	12.4	35.8	13.7	36.9
	2 to 3	8.2	42.6	7.7	42.6	7.2	43.0	5.6	42.5		2 to 3	8.2	42.6	7.7	42.6	7.2	43.0	5.6	42.5
	3 to 5	4.8	47.5	4.1	46.7	3.0	46.0	3.0	45.5		3 to 5	4.8	47.5	4.1	46.7	3.0	46.0	3.0	45.5
5 to Finish	2.5	50.0	3.3	50.0	4.0	50.0	4.5	50.0	5 to Finish	2.5	50.0	3.3	50.0	4.0	50.0	4.5	50.0		
13	0.36		0.45		0.54		0.58		03	0.36		0.45		0.54		0.58			
	Start to 1	8.5	8.5	9.0	9.0	9.8	9.8	10.8		10.8	Start to 1	8.5	8.5	9.0	9.0	9.8	9.8	10.8	10.8
	1 to 4	6.0	14.6	5.6	14.6	5.2	15.0	4.1		14.9	1 to 2	3.6	12.1	3.0	12.0	2.2	12.0	2.1	12.9
	4 to 1	7.5	22.0	8.1	22.7	9.0	23.9	9.9		24.8	2 to 3	6.0	18.1	5.6	17.6	5.2	17.1	4.1	17.0
	1 to 4	6.0	28.1	5.6	28.4	5.2	29.1	4.1		28.9	3 to 2	7.5	25.6	8.1	25.7	9.0	26.1	9.9	26.9
	4 to 1	7.5	35.5	8.1	36.5	9.0	38.1	9.9		38.8	2 to 3	6.0	31.6	5.6	31.4	5.2	31.3	4.1	31.0
1 to 2	3.6	39.1	3.0	39.5	2.2	40.2	2.1	40.9	3 to 2	7.5	39.1	8.1	39.5	9.0	40.2	9.9	40.9		
2 to 3	6.0	45.1	5.6	45.1	5.2	45.4	4.1	45.0	2 to 3	6.0	45.1	5.6	45.1	5.2	45.4	4.1	45.0		
3 to 5	3.6	48.7	3.0	48.1	2.2	47.6	2.1	47.2	3 to 5	3.6	48.7	3.0	48.1	2.2	47.6	2.1	47.2		
5 to Finish	1.3	50.0	1.9	50.0	2.4	50.0	2.8	50.0	5 to Finish	1.3	50.0	1.9	50.0	2.4	50.0	2.8	50.0		
14	0.28		0.35		0.43		0.46		04	0.28		0.35		0.43		0.46			
	Start to 1	7.0	7.0	7.3	7.3	7.8	7.8	8.6		8.6	Start to 1	7.0	7.0	7.3	7.3	7.8	7.8	8.6	8.6
	1 to 4	4.8	11.7	4.4	11.7	4.0	11.9	3.2		11.8	1 to 2	2.8	9.8	2.4	9.6	1.7	9.5	1.7	10.3
	4 to 1	5.9	17.6	6.4	18.1	7.0	18.9	7.8		19.6	2 to 3	4.8	14.5	4.4	14.1	4.0	13.6	3.2	13.5
	1 to 4	4.8	22.4	4.4	22.5	4.0	22.9	3.2		22.8	3 to 2	5.9	20.4	6.4	20.5	7.0	20.6	7.8	21.3
	4 to 1	5.9	28.3	6.4	28.9	7.0	30.0	7.8		30.6	2 to 3	4.8	25.2	4.4	24.9	4.0	24.6	3.2	24.5
1 to 4	4.8	33.1	4.4	33.3	4.0	34.0	3.2	33.8	3 to 2	5.9	31.1	6.4	31.3	7.0	31.7	7.8	32.3		
4 to 1	5.9	39.0	6.4	39.7	7.0	41.0	7.8	41.6	2 to 3	4.8	35.9	4.4	35.7	4.0	35.7	3.2	35.5		
1 to 2	2.8	41.8	2.4	42.1	1.7	42.7	1.7	43.3	3 to 2	5.9	41.8	6.4	42.1	7.0	42.7	7.8	43.3		
2 to 3	4.8	46.6	4.4	46.5	4.0	46.7	3.2	46.5	2 to 3	4.8	46.6	4.4	46.5	4.0	46.7	3.2	46.5		
3 to 5	2.8	49.4	2.4	48.9	1.7	48.5	1.7	48.2	3 to 5	2.8	49.4	2.4	48.9	1.7	48.5	1.7	48.2		
5 to Finish	0.6	50.0	1.1	50.0	1.5	50.0	1.8	50.0	5 to Finish	0.6	50.0	1.1	50.0	1.5	50.0	1.8	50.0		

RADIAL - Leeward, target time 50 minutes.



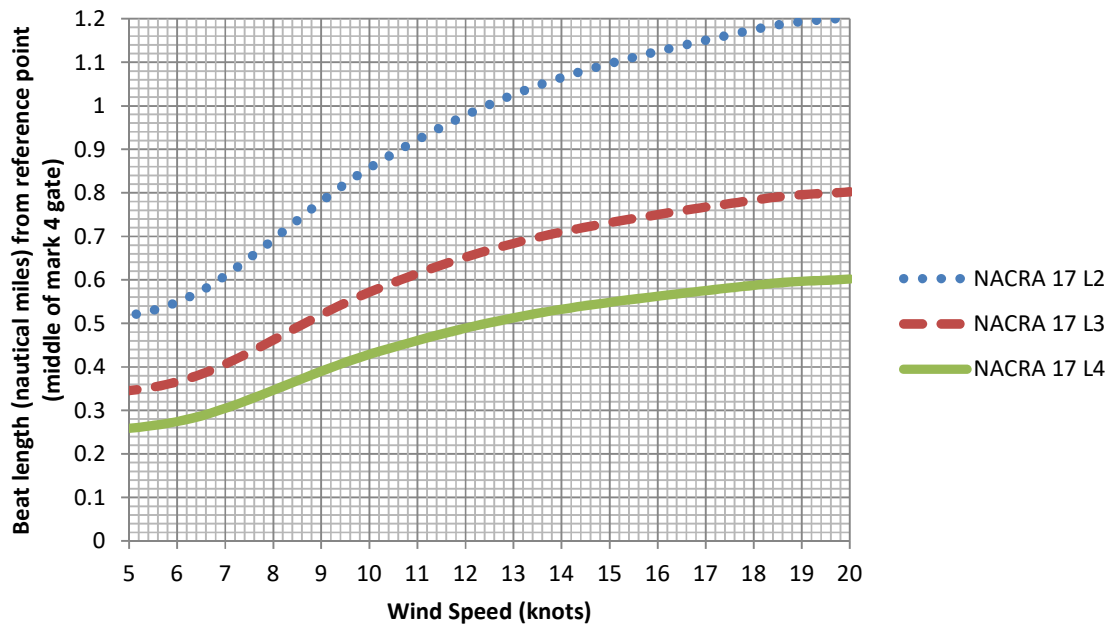
Anticipated leg times for RADIAL Leeward with race target time of 50 minutes

Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.63		0.79		0.94		1.02	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	14.3	14.3	15.2	15.2	16.3	16.3	18.1	18.1
	1 to 4	10.8	25.1	9.9	25.1	8.9	25.2	7.1	25.3
	4 to 1	13.3	38.4	14.3	39.4	15.5	40.6	17.3	42.5
	1 to Finish	11.6	50.0	10.6	50.0	9.4	50.0	7.5	50.0
L3	Leg Length	0.42		0.53		0.62		0.68	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.9	9.9	10.4	10.4	11.1	11.1	12.4	12.4
	1 to 4	7.2	17.1	6.6	17.1	5.9	17.1	4.7	17.1
	4 to 1	8.9	25.9	9.5	26.6	10.3	27.4	11.5	28.6
	1 to 4	7.2	33.1	6.6	33.2	5.9	33.3	4.7	33.4
	4 to 1	8.9	42.0	9.5	42.8	10.3	43.6	11.5	44.9
1 to Finish	8.0	50.0	7.2	50.0	6.4	50.0	5.1	50.0	
L4	Leg Length	0.32		0.40		0.47		0.51	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	7.7	7.7	8.1	8.1	8.6	8.6	9.5	9.5
	1 to 4	5.4	13.1	5.0	13.0	4.4	13.0	3.6	13.1
	4 to 1	6.6	19.7	7.2	20.2	7.7	20.7	8.6	21.7
	1 to 4	5.4	25.1	5.0	25.1	4.4	25.2	3.6	25.3
	4 to 1	6.6	31.7	7.2	32.3	7.7	32.9	8.6	33.9
	1 to 4	5.4	37.1	5.0	37.3	4.4	37.4	3.6	37.5
	4 to 1	6.6	43.8	7.2	44.4	7.7	45.1	8.6	46.1
1 to Finish	6.2	50.0	5.6	50.0	4.9	50.0	3.9	50.0	

RADIAL 70° 110° Trapezoid with beat to finish (finish 0.05 below the starting line)																				
Wind Range	5 - 8 Knots					8 - 12 Knots					12 - 15 Knots					15+ Knots				
Upwind speed	21 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	18 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	16.5 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	17 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)
Run Speed	17 min/mile					12.5 min/mile					9.5 min/mile					7 min/mile				
Reach speed	15 min/mile					10 min/mile					6 min/mile					5.5 min/mile				
Beat length Nautical Miles (Ref to 1)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)	Up time	Down time	Up and Down	One Reach time 2/3 beat	Finish leg time (5 - F)
0.30	6.3	5.1	11.4	3.0	0.6	5.4	3.8	9.2	2.0	0.4	5.0	2.9	7.8	1.2	0.2	5.1	2.1	7.2	1.1	0.2
0.35	7.4	6.0	13.3	3.5	0.9	6.3	4.4	10.7	2.3	0.6	5.8	3.3	9.1	1.4	0.4	6.0	2.5	8.4	1.3	0.3
0.40	8.4	6.8	15.2	4.0	1.2	7.2	5.0	12.2	2.7	0.8	6.6	3.8	10.4	1.6	0.5	6.8	2.8	9.6	1.5	0.5
0.45	9.5	7.7	17.1	4.5	1.6	8.1	5.6	13.7	3.0	1.1	7.4	4.3	11.7	1.8	0.6	7.7	3.2	10.8	1.7	0.6
0.50	10.5	8.5	19.0	5.0	1.9	9.0	6.3	15.3	3.3	1.3	8.3	4.8	13.0	2.0	0.8	8.5	3.5	12.0	1.8	0.7
0.55	11.6	9.4	20.9	5.5	2.3	9.9	6.9	16.8	3.7	1.5	9.1	5.2	14.3	2.2	0.9	9.4	3.9	13.2	2.0	0.8
0.60	12.6	10.2	22.8	6.0	2.6	10.8	7.5	18.3	4.0	1.7	9.9	5.7	15.6	2.4	1.0	10.2	4.2	14.4	2.2	1.0
0.65	13.7	11.1	24.7	6.5	2.9	11.7	8.1	19.8	4.3	2.0	10.7	6.2	16.9	2.6	1.2	11.1	4.6	15.6	2.4	1.1
0.70	14.7	11.9	26.6	7.0	3.3	12.6	8.8	21.4	4.7	2.2	11.6	6.7	18.2	2.8	1.3	11.9	4.9	16.8	2.6	1.2
0.75	15.8	12.8	28.5	7.5	3.6	13.5	9.4	22.9	5.0	2.4	12.4	7.1	19.5	3.0	1.5	12.8	5.3	18.0	2.8	1.3
0.80	16.8	13.6	30.4	8.0	4.0	14.4	10.0	24.4	5.3	2.6	13.2	7.6	20.8	3.2	1.6	13.6	5.6	19.2	2.9	1.5
0.85	17.9	14.5	32.3	8.5	4.3	15.3	10.6	25.9	5.7	2.9	14.0	8.1	22.1	3.4	1.7	14.5	6.0	20.4	3.1	1.6
0.90	18.9	15.3	34.2	9.0	4.7	16.2	11.3	27.5	6.0	3.1	14.9	8.6	23.4	3.6	1.9	15.3	6.3	21.6	3.3	1.7
0.95	20.0	16.2	36.1	9.5	5.0	17.1	11.9	29.0	6.3	3.3	15.7	9.0	24.7	3.8	2.0	16.2	6.7	22.8	3.5	1.8
1.00	21.0	17.0	38.0	10.0	5.3	18.0	12.5	30.5	6.7	3.6	16.5	9.5	26.0	4.0	2.1	17.0	7.0	24.0	3.7	2.0
1.05	22.1	17.9	39.9	10.5	5.7	18.9	13.1	32.0	7.0	3.8	17.3	10.0	27.3	4.2	2.3	17.9	7.4	25.2	3.9	2.1
1.10	23.1	18.7	41.8	11.0	6.0	19.8	13.8	33.6	7.3	4.0	18.2	10.5	28.6	4.4	2.4	18.7	7.7	26.4	4.0	2.2
1.15	24.2	19.6	43.7	11.5	6.4	20.7	14.4	35.1	7.7	4.2	19.0	10.9	29.9	4.6	2.5	19.6	8.1	27.6	4.2	2.3
1.20	25.2	20.4	45.6	12.0	6.7	21.6	15.0	36.6	8.0	4.5	19.8	11.4	31.2	4.8	2.7	20.4	8.4	28.8	4.4	2.5
1.25	26.3	21.3	47.5	12.5	7.1	22.5	15.6	38.1	8.3	4.7	20.6	11.9	32.5	5.0	2.8	21.3	8.8	30.0	4.6	2.6
1.30	27.3	22.1	49.4	13.0	7.4	23.4	16.3	39.7	8.7	4.9	21.5	12.4	33.8	5.2	3.0	22.1	9.1	31.2	4.8	2.7
1.35	28.4	23.0	51.3	13.5	7.7	24.3	16.9	41.2	9.0	5.2	22.3	12.8	35.1	5.4	3.1	23.0	9.5	32.4	5.0	2.8
1.40	29.4	23.8	53.2	14.0	8.1	25.2	17.5	42.7	9.3	5.4	23.1	13.3	36.4	5.6	3.2	23.8	9.8	33.6	5.1	3.0

Time from Start to Reference (0.05NM) and Reference to Finish (0.05 NM (Downwind finish))											
0.05	1.1	0.9		0.9	0.6		0.8	0.5		0.9	0.4
Time for reaching leg from gate to finish of 0.15 NM											
0.15			2.25			1.5			0.9		0.8

NACRA 17 - Leeward, target time 30 minutes.

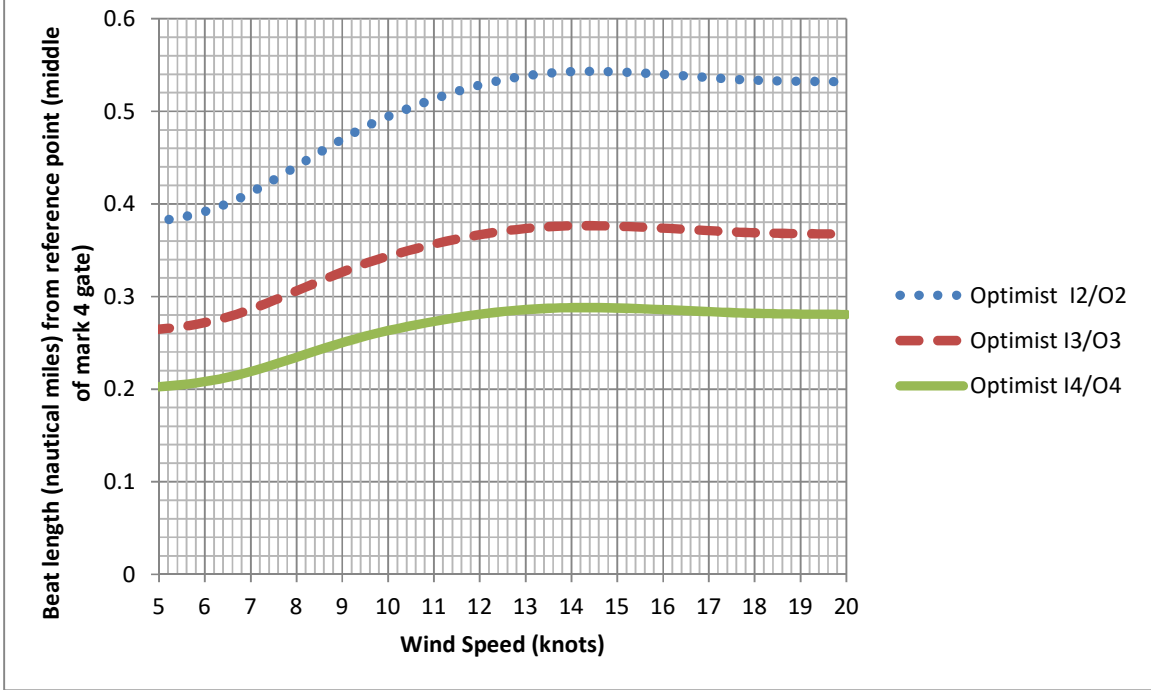


Anticipated leg times for NACRA 17 Leeward with race target time of 30 minutes

Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.58		0.86		1.05		1.18	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	10.0	10.0	10.4	10.4	9.9	9.9	9.8	9.8
	1 to 4	5.2	15.2	4.7	15.2	5.2	15.1	5.3	15.1
	4 to 1	9.2	24.4	9.9	25.0	9.4	24.5	9.4	24.5
1 to Finish	5.6	30.0	5.0	30.0	5.5	30.0	5.5	30.0	
L3	Leg Length	0.38		0.57		0.70		0.78	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	6.9	6.9	7.1	7.1	6.7	6.7	6.7	6.7
	1 to 4	3.5	10.4	3.1	10.3	3.5	10.2	3.5	10.2
	4 to 1	6.1	16.5	6.6	16.9	6.3	16.5	6.3	16.5
	1 to 4	3.5	20.0	3.1	20.0	3.5	20.0	3.5	20.0
	4 to 1	6.1	26.1	6.6	26.6	6.3	26.3	6.3	26.3
1 to Finish	3.9	30.0	3.4	30.0	3.7	30.0	3.8	30.0	
L4	Leg Length	0.29		0.43		0.52		0.59	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	5.4	5.4	5.5	5.5	5.2	5.2	5.1	5.1
	1 to 4	2.6	8.0	2.4	7.9	2.6	7.8	2.6	7.7
	4 to 1	4.6	12.6	4.9	12.8	4.7	12.5	4.7	12.4
	1 to 4	2.6	15.2	2.4	15.2	2.6	15.1	2.6	15.1
	4 to 1	4.6	19.8	4.9	20.1	4.7	19.8	4.7	19.8
	1 to 4	2.6	22.4	2.4	22.4	2.6	22.4	2.6	22.4
	4 to 1	4.6	27.0	4.9	27.4	4.7	27.1	4.7	27.1
1 to Finish	3.0	30.0	2.6	30.0	2.9	30.0	2.9	30.0	

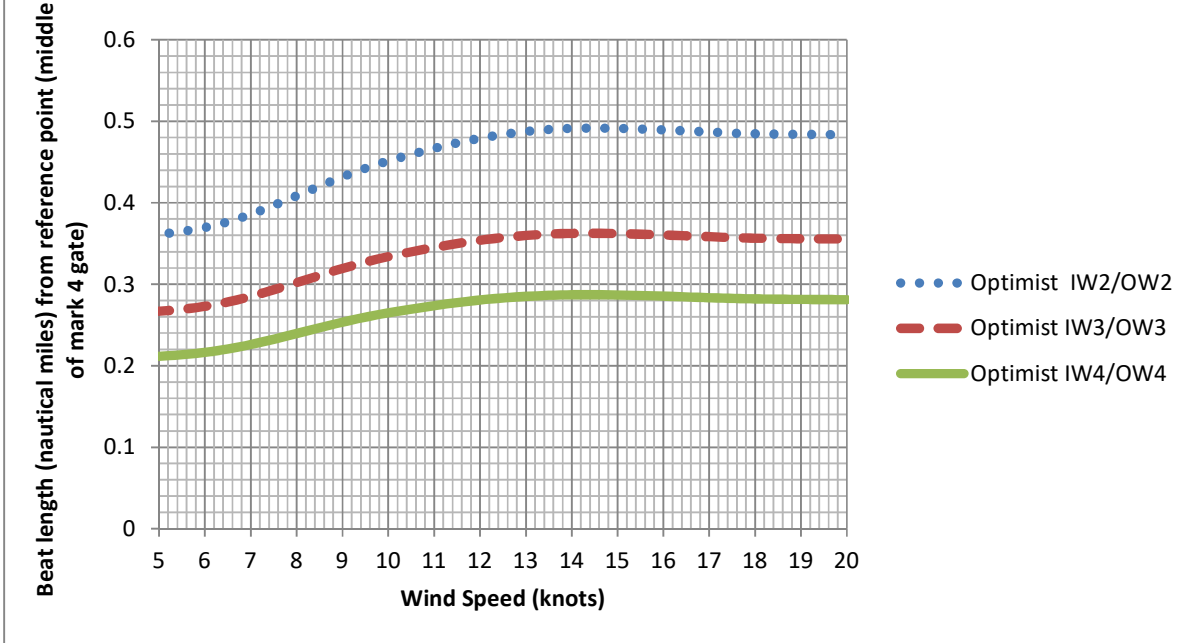
NACRA 17 Leeward																			
Wind Range	5 - 8 Knots				8 - 12 Knots				12 - 15 Knots				15+ Knots						
Upwind speed	16 min/mile			Finish on reach leg time (LG/LR)	11.5 min/mile			Finish on reach leg time (LG/LR)	9 min/mile			Finish on reach leg time (LG/LR)	8 min/mile			Finish on reach leg time (LG/LR)			
Run Speed	9 min/mile				5.5 min/mile				5 min/mile				4.5 min/mile						
Reach speed	7 min/mile				3.5 min/mile				3 min/mile				2.5 min/mile						
Leg length Nautical Miles	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	
0.30	4.8	2.7	7.5	1.1	3.5	1.7	5.1	0.5	2.7	1.5	4.2	0.5	2.4	1.4	3.8	0.4			
0.35	5.6	3.2	8.8	1.1	4.0	1.9	6.0	0.5	3.2	1.8	4.9	0.5	2.8	1.6	4.4	0.4			
0.40	6.4	3.6	10.0	1.1	4.6	2.2	6.8	0.5	3.6	2.0	5.6	0.5	3.2	1.8	5.0	0.4			
0.45	7.2	4.1	11.3	1.1	5.2	2.5	7.7	0.5	4.1	2.3	6.3	0.5	3.6	2.0	5.6	0.4			
0.50	8.0	4.5	12.5	1.1	5.8	2.8	8.5	0.5	4.5	2.5	7.0	0.5	4.0	2.3	6.3	0.4			
0.55	8.8	5.0	13.8	1.1	6.3	3.0	9.4	0.5	5.0	2.8	7.7	0.5	4.4	2.5	6.9	0.4			
0.60	9.6	5.4	15.0	1.1	6.9	3.3	10.2	0.5	5.4	3.0	8.4	0.5	4.8	2.7	7.5	0.4			
0.65	10.4	5.9	16.3	1.1	7.5	3.6	11.1	0.5	5.9	3.3	9.1	0.5	5.2	2.9	8.1	0.4			
0.70	11.2	6.3	17.5	1.1	8.1	3.9	11.9	0.5	6.3	3.5	9.8	0.5	5.6	3.2	8.8	0.4			
0.75	12.0	6.8	18.8	1.1	8.6	4.1	12.8	0.5	6.8	3.8	10.5	0.5	6.0	3.4	9.4	0.4			
0.80	12.8	7.2	20.0	1.1	9.2	4.4	13.6	0.5	7.2	4.0	11.2	0.5	6.4	3.6	10.0	0.4			
0.85	13.6	7.7	21.3	1.1	9.8	4.7	14.5	0.5	7.7	4.3	11.9	0.5	6.8	3.8	10.6	0.4			
0.90	14.4	8.1	22.5	1.1	10.4	5.0	15.3	0.5	8.1	4.5	12.6	0.5	7.2	4.1	11.3	0.4			
0.95	15.2	8.6	23.8	1.1	10.9	5.2	16.2	0.5	8.6	4.8	13.3	0.5	7.6	4.3	11.9	0.4			
1.00	16.0	9.0	25.0	1.1	11.5	5.5	17.0	0.5	9.0	5.0	14.0	0.5	8.0	4.5	12.5	0.4			
1.05	16.8	9.5	26.3	1.1	12.1	5.8	17.9	0.5	9.5	5.3	14.7	0.5	8.4	4.7	13.1	0.4			
1.10	17.6	9.9	27.5	1.1	12.7	6.1	18.7	0.5	9.9	5.5	15.4	0.5	8.8	5.0	13.8	0.4			
1.15	18.4	10.4	28.8	1.1	13.2	6.3	19.6	0.5	10.4	5.8	16.1	0.5	9.2	5.2	14.4	0.4			
1.20	19.2	10.8	30.0	1.1	13.8	6.6	20.4	0.5	10.8	6.0	16.8	0.5	9.6	5.4	15.0	0.4			
1.25	20.0	11.3	31.3	1.1	14.4	6.9	21.3	0.5	11.3	6.3	17.5	0.5	10.0	5.6	15.6	0.4			
1.30	20.8	11.7	32.5	1.1	15.0	7.2	22.1	0.5	11.7	6.5	18.2	0.5	10.4	5.9	16.3	0.4			
1.35	21.6	12.2	33.8	1.1	15.5	7.4	23.0	0.5	12.2	6.8	18.9	0.5	10.8	6.1	16.9	0.4			
1.40	22.4	12.6	35.0	1.1	16.1	7.7	23.8	0.5	12.6	7.0	19.6	0.5	11.2	6.3	17.5	0.4			

Optimist - Trapezoid, target time 50 minutes.



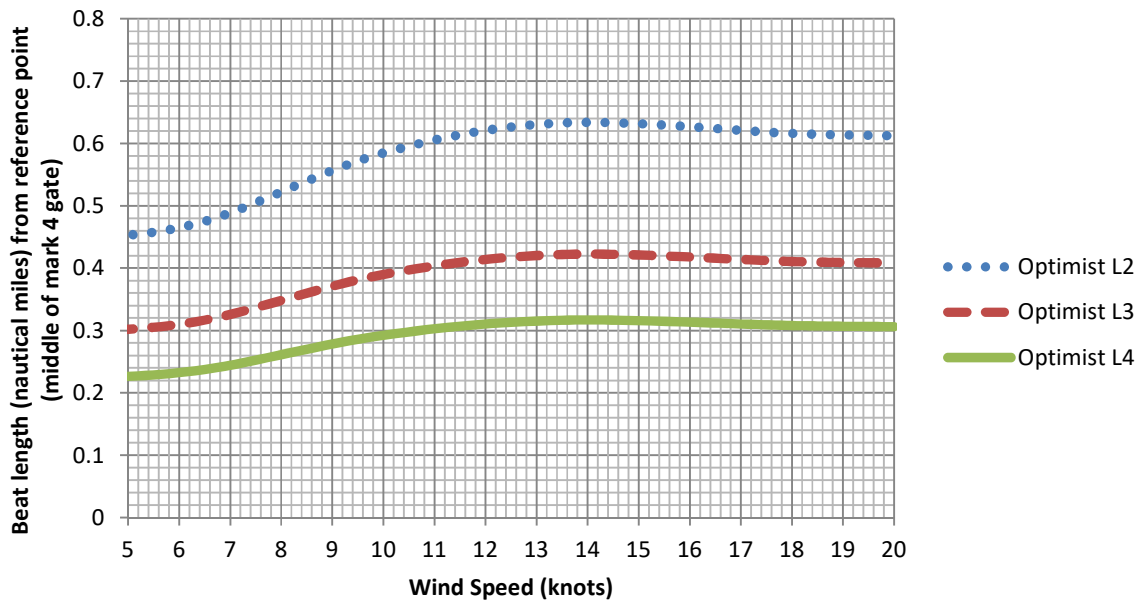
Anticipated leg times for Optimist Trapezoid with a race target time 50 minutes																			
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+	
Average beat		0.40		0.49		0.54		0.53		Average beat		0.40		0.49		0.54		0.53	
I2		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O2		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	14.4	14.4	14.2	14.2	14.2	14.2	15.2	15.2		Start to 1	14.4	14.4	14.2	14.2	14.2	14.2	15.2	15.2
	1 to 4	7.2	21.6	7.4	21.6	7.6	21.8	6.9	22.1		1 to 2	5.3	19.8	5.6	19.8	5.4	19.6	5.0	20.2
	4 to 1	12.8	34.4	12.9	34.4	13.0	34.8	13.9	36.0		2 to 3	7.2	27.0	7.4	27.2	7.6	27.2	6.9	27.1
	1 to 2	5.3	39.8	5.6	40.0	5.4	40.2	5.0	41.0		3 to 2	12.8	39.8	12.9	40.0	13.0	40.2	13.9	41.0
	2 to 3	7.2	47.0	7.4	47.5	7.6	47.8	6.9	47.9		2 to 3	7.2	47.0	7.4	47.5	7.6	47.8	6.9	47.9
	3 to Finish	3.0	50.0	2.6	50.0	2.3	50.0	2.1	50.0		3 to Finish	3.0	50.0	2.6	50.0	2.3	50.0	2.1	50.0
	Average beat		0.28		0.34		0.38		0.37		Average beat		0.28		0.34		0.38		0.37
I3		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O3		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	10.5	10.5	10.2	10.2	10.2	10.2	10.9	10.9		Start to 1	10.5	10.5	10.2	10.2	10.2	10.2	10.9	10.9
	1 to 4	5.0	15.5	5.2	15.4	5.3	15.5	4.8	15.7		1 to 2	3.7	14.2	3.9	14.1	3.8	14.0	3.4	14.3
	4 to 1	8.9	24.4	8.9	24.3	9.0	24.5	9.6	25.3		2 to 3	5.0	19.2	5.2	19.3	5.3	19.2	4.8	19.1
	1 to 4	5.0	29.4	5.2	29.5	5.3	29.7	4.8	30.1		3 to 2	8.9	28.1	8.9	28.2	9.0	28.2	9.6	28.7
	4 to 1	8.9	38.3	8.9	38.4	9.0	38.7	9.6	39.7		2 to 3	5.0	33.1	5.2	33.4	5.3	33.5	4.8	33.5
	1 to 2	3.7	42.0	3.9	42.3	3.8	42.5	3.4	43.1		3 to 2	8.9	42.0	8.9	42.3	9.0	42.5	9.6	43.1
	2 to 3	5.0	47.0	5.2	47.5	5.3	47.8	4.8	47.9		2 to 3	5.0	47.0	5.2	47.5	5.3	47.8	4.8	47.9
3 to Finish	3.0	50.0	2.6	50.0	2.3	50.0	2.1	50.0	3 to Finish	3.0	50.0	2.6	50.0	2.3	50.0	2.1	50.0		
Average beat		0.21		0.26		0.29		0.28		Average beat		0.21		0.26		0.29		0.28	
I4		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	O4		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	8.4	8.4	8.1	8.1	8.1	8.1	8.6	8.6		Start to 1	8.4	8.4	8.1	8.1	8.1	8.1	8.6	8.6
	1 to 4	3.8	12.2	3.9	12.1	4.0	12.1	3.7	12.3		1 to 2	2.8	11.2	3.0	11.1	2.9	11.0	2.6	11.3
	4 to 1	6.8	19.1	6.8	18.9	6.9	19.0	7.3	19.6		2 to 3	3.8	15.1	3.9	15.1	4.0	15.0	3.7	14.9
	1 to 4	3.8	22.9	3.9	22.9	4.0	23.0	3.7	23.3		3 to 2	6.8	21.9	6.8	21.9	6.9	21.9	7.3	22.3
	4 to 1	6.8	29.7	6.8	29.7	6.9	29.9	7.3	30.6		2 to 3	3.8	25.7	3.9	25.9	4.0	25.9	3.7	25.9
	1 to 4	3.8	33.5	3.9	33.7	4.0	34.0	3.7	34.3		3 to 2	6.8	32.5	6.8	32.7	6.9	32.8	7.3	33.2
	4 to 1	6.8	40.3	6.8	40.5	6.9	40.9	7.3	41.6		2 to 3	3.8	36.4	3.9	36.7	4.0	36.8	3.7	36.9
1 to 2	2.8	43.2	3.0	43.5	2.9	43.7	2.6	44.2	3 to 2	6.8	43.2	6.8	43.5	6.9	43.7	7.3	44.2		
2 to 3	3.8	47.0	3.9	47.5	4.0	47.8	3.7	47.9	2 to 3	3.8	47.0	3.9	47.5	4.0	47.8	3.7	47.9		
3 to Finish	3.0	50.0	2.6	50.0	2.3	50.0	2.1	50.0	3 to Finish	3.0	50.0	2.6	50.0	2.3	50.0	2.1	50.0		

Optimist - Trapezoid with beat to finish, target time 50 minutes.



Anticipated leg times for Optimist Trapezoid with beat to finish with a race target time 50 minutes																			
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+	
Average beat		0.37		0.44		0.48		0.47		Average beat		0.37		0.44		0.48		0.47	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total			Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
12	Start to 1	13.3	13.3	12.7	12.7	12.7	12.7	13.6	13.6	02	Start to 1	13.3	13.3	12.7	12.7	12.7	12.7	13.6	13.6
	1 to 4	6.6	19.9	6.6	19.4	6.7	19.4	6.1	19.7		1 to 2	4.9	18.2	5.0	17.7	4.8	17.5	4.4	18.0
	4 to 1	11.7	31.6	11.4	30.8	11.5	30.9	12.3	32.0		2 to 3	6.6	24.7	6.6	24.3	6.7	24.2	6.1	24.1
	1 to 2	4.9	36.4	5.0	35.8	4.8	35.7	4.4	36.4		3 to 2	11.7	36.4	11.4	35.8	11.5	35.7	12.3	36.4
	2 to 3	6.6	43.0	6.6	42.4	6.7	42.4	6.1	42.6		2 to 3	6.6	43.0	6.6	42.4	6.7	42.4	6.1	42.6
	3 to 5	4.9	47.9	5.0	47.4	4.8	47.2	4.4	47.0		3 to 5	4.9	47.9	5.0	47.4	4.8	47.2	4.4	47.0
	5 to Finish	2.1	50.0	2.6	50.0	2.8	50.0	3.0	50.0		5 to Finish	2.1	50.0	2.6	50.0	2.8	50.0	3.0	50.0
Average beat		0.27		0.33		0.35		0.35		Average beat		0.27		0.33		0.35		0.35	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total			Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
13	Start to 1	10.2	10.2	9.8	9.8	9.7	9.7	10.3	10.3	03	Start to 1	10.2	10.2	9.8	9.8	9.7	9.7	10.3	10.3
	1 to 4	4.9	15.1	4.9	14.7	4.9	14.6	4.5	14.9		1 to 2	3.6	13.8	3.7	13.5	3.5	13.2	3.2	13.6
	4 to 1	8.6	23.7	8.5	23.1	8.5	23.1	9.0	23.9		2 to 3	4.9	18.7	4.9	18.3	4.9	18.2	4.5	18.1
	1 to 4	4.9	28.6	4.9	28.0	4.9	28.0	4.5	28.4		3 to 2	8.6	27.3	8.5	26.8	8.5	26.6	9.0	27.1
	4 to 1	8.6	37.2	8.5	36.5	8.5	36.5	9.0	37.5		2 to 3	4.9	32.2	4.9	31.7	4.9	31.6	4.5	31.7
	1 to 2	3.6	40.8	3.7	40.2	3.5	40.1	3.2	40.7		3 to 2	8.6	40.8	8.5	40.2	8.5	40.1	9.0	40.7
	2 to 3	4.9	45.7	4.9	45.0	4.9	45.0	4.5	45.2		2 to 3	4.9	45.7	4.9	45.0	4.9	45.0	4.5	45.2
3 to 5	3.6	49.3	3.7	48.7	3.5	48.5	3.2	48.5	3 to 5	3.6	49.3	3.7	48.7	3.5	48.5	3.2	48.5		
5 to Finish	0.7	50.0	1.3	50.0	1.5	50.0	1.5	50.0	5 to Finish	0.7	50.0	1.3	50.0	1.5	50.0	1.5	50.0		
Average beat		0.21		0.26		0.28		0.28		Average beat		0.21		0.26		0.28		0.28	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total			Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
14	Start to 1	8.4	8.4	8.0	8.0	7.9	7.9	8.5	8.5	04	Start to 1	8.4	8.4	8.0	8.0	7.9	7.9	8.5	8.5
	1 to 4	3.8	12.3	3.9	11.9	3.9	11.8	3.6	12.0		1 to 2	2.9	11.3	2.9	10.9	2.8	10.7	2.6	11.0
	4 to 1	6.8	19.1	6.7	18.6	6.7	18.6	7.2	19.2		2 to 3	3.8	15.1	3.9	14.8	3.9	14.6	3.6	14.6
	1 to 4	3.8	23.0	3.9	22.5	3.9	22.5	3.6	22.8		3 to 2	6.8	22.0	6.7	21.5	6.7	21.4	7.2	21.7
	4 to 1	6.8	29.8	6.7	29.2	6.7	29.2	7.2	29.9		2 to 3	3.8	25.8	3.9	25.4	3.9	25.3	3.6	25.3
	1 to 4	3.8	33.7	3.9	33.1	3.9	33.1	3.6	33.5		3 to 2	6.8	32.7	6.7	32.1	6.7	32.0	7.2	32.5
	4 to 1	6.8	40.5	6.7	39.8	6.7	39.8	7.2	40.6		2 to 3	3.8	36.5	3.9	36.0	3.9	35.9	3.6	36.0
	1 to 2	2.9	43.4	2.9	42.7	2.8	42.6	2.6	43.2		3 to 2	6.8	43.4	6.7	42.7	6.7	42.6	7.2	43.2
	2 to 3	3.8	47.2	3.9	46.6	3.9	46.5	3.6	46.8		2 to 3	3.8	47.2	3.9	46.6	3.9	46.5	3.6	46.8
	3 to 5	2.9	50.1	2.9	49.5	2.8	49.3	2.6	49.3		3 to 5	2.9	50.1	2.9	49.5	2.8	49.3	2.6	49.3
5 to Finish	-0.1	50.0	0.5	50.0	0.7	50.0	0.7	50.0	5 to Finish	-0.1	50.0	0.5	50.0	0.7	50.0	0.7	50.0		

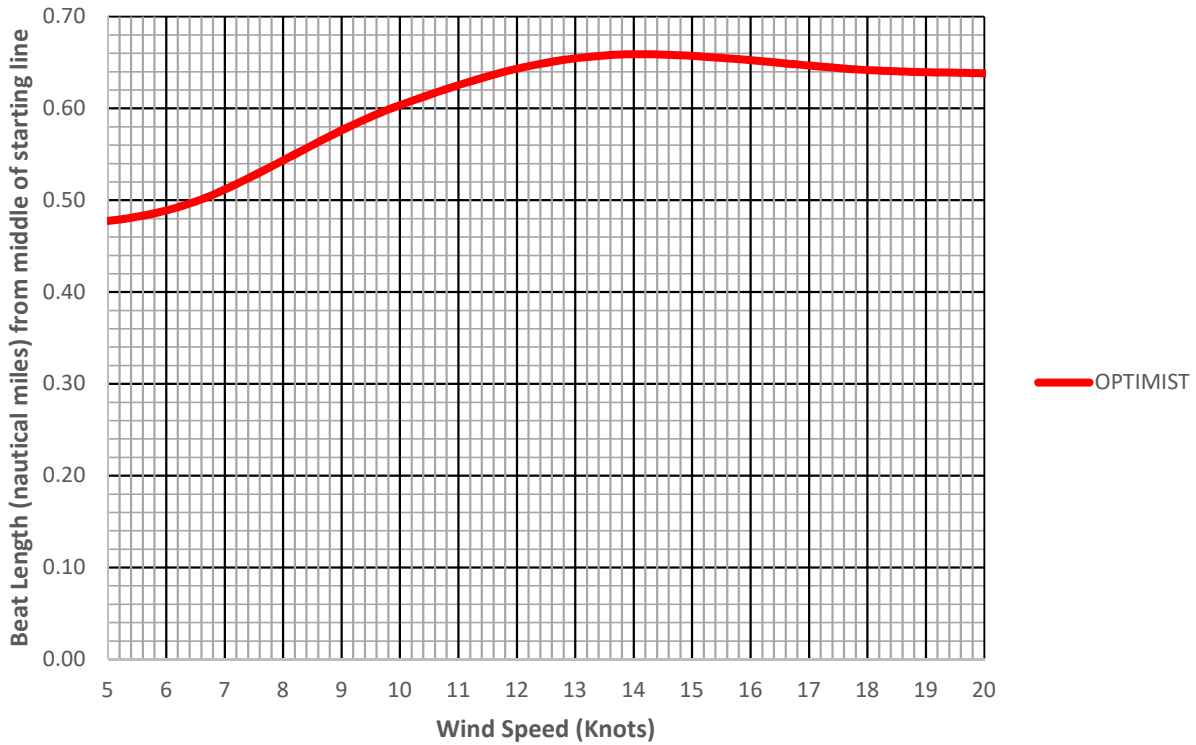
Optimist - Leeward, target time 50 minutes.



Anticipated leg times for Optimist Leeward with race target time of 50 minutes

Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.48		0.58		0.63		0.62	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	16.8	16.8	16.5	16.5	16.4	16.4	17.3	17.3
	1 to 4	8.6	25.4	8.8	25.3	8.9	25.3	8.0	25.3
	4 to 1	15.2	40.6	15.2	40.5	15.2	40.4	16.0	41.3
	1 to Finish	9.5	50.0	9.5	50.0	9.6	50.0	8.7	50.0
L3	Leg Length	0.32		0.39		0.42		0.41	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	11.7	11.7	11.4	11.4	11.3	11.3	12.0	12.0
	1 to 4	5.7	17.4	5.8	17.3	5.9	17.2	5.3	17.3
	4 to 1	10.1	27.6	10.1	27.4	10.1	27.4	10.7	28.0
	1 to 4	5.7	33.3	5.8	33.3	5.9	33.3	5.3	33.3
	4 to 1	10.1	43.4	10.1	43.4	10.1	43.4	10.7	44.0
1 to Finish	6.6	50.0	6.6	50.0	6.6	50.0	6.0	50.0	
L4	Leg Length	0.24		0.29		0.32		0.31	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	9.2	9.2	8.9	8.9	8.8	8.8	9.3	9.3
	1 to 4	4.3	13.5	4.4	13.3	4.4	13.2	4.0	13.3
	4 to 1	7.6	21.1	7.6	20.9	7.6	20.8	8.0	21.3
	1 to 4	4.3	25.4	4.4	25.3	4.4	25.3	4.0	25.3
	4 to 1	7.6	33.0	7.6	32.9	7.6	32.8	8.0	33.3
	1 to 4	4.3	37.2	4.4	37.3	4.4	37.3	4.0	37.3
	4 to 1	7.6	44.8	7.6	44.9	7.6	44.9	8.0	45.3
1 to Finish	5.2	50.0	5.1	50.0	5.1	50.0	4.7	50.0	

OPTIMIST IOD Course all legs equal in length, reach 120 off the wind



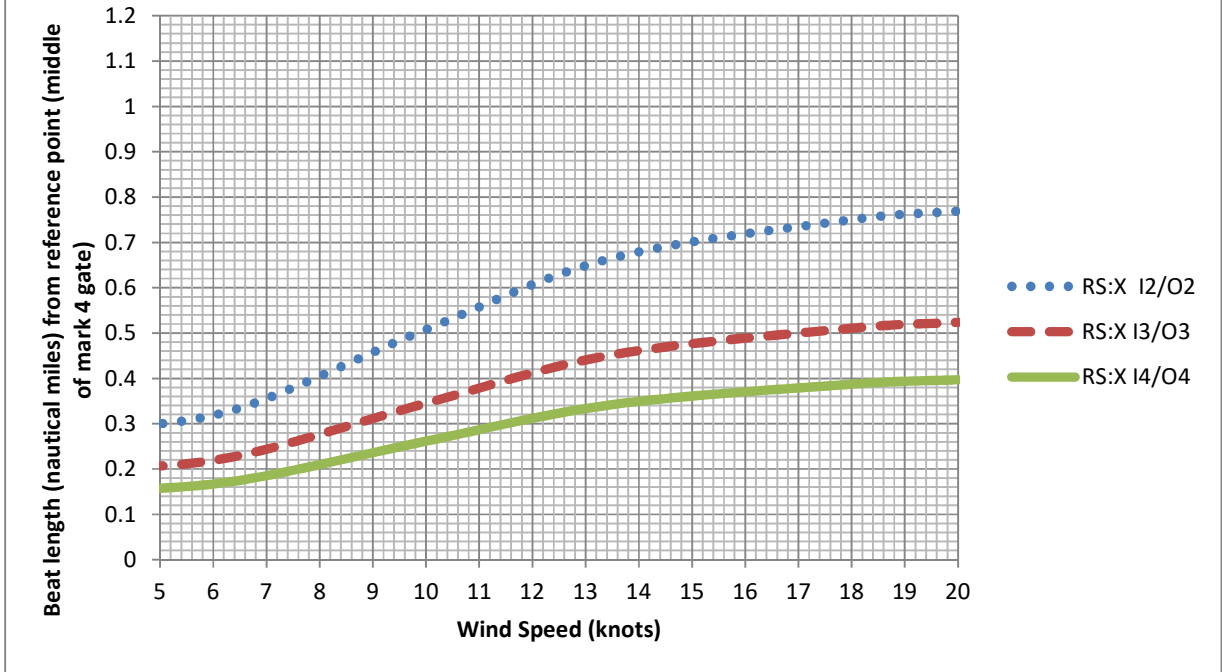
Anticipated leg times for OPTIMIST IOD course, target time 50 minutes									
Wind Range		5 - 8 knots		8 - 12 knots		12 - 15 knots		15+ knots	
Beat Length		0.50 NM		0.60 NM		0.66 NM		0.64 NM	
Course	Leg	Leg Time	Total	Leg Time	Total	Leg Time	Total	Leg Time	Total
IOD	Start to 1	16.0	16.0	15.7	15.7	15.8	15.8	16.7	16.7
	1 to 2	10.0	25.9	10.3	26.0	9.9	25.7	9.0	25.7
	2 to 3	9.0	34.9	9.1	35.0	9.2	34.9	8.3	34.0
	3 to Finish	15.1	50.0	15.0	50.0	15.1	50.0	16.0	50.0

Finish 50 metres downwind and to the right of mark 2

Optimist 70° 110° Trapezoid with beat to finish (finish 0.05 below the starting line)																					
Wind Range	5 - 8 Knots					8 - 12 Knots					12 - 15 Knots					15+ Knots					
Upwind speed	32 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	26 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	24 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	26 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	
Run Speed	18 min/mile					15 min/mile					14 min/mile					13 min/mile					
Reach speed	20 min/mile					17 min/mile					15 min/mile					14 min/mile					
Beat length Nautical Miles (Ref to 1)	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down	Up time	Down time	Up and Down
0.30	9.6	5.4	15.0	4.0	0.7	7.8	4.5	12.3	3.4	0.6	7.2	4.2	11.4	3.0	0.6	7.8	3.9	11.7	2.8	0.5	
0.35	11.2	6.3	17.5	4.7	1.2	9.1	5.3	14.4	4.0	1.0	8.4	4.9	13.3	3.5	0.9	9.1	4.6	13.7	3.3	0.8	
0.40	12.8	7.2	20.0	5.3	1.6	10.4	6.0	16.4	4.5	1.4	9.6	5.6	15.2	4.0	1.2	10.4	5.2	15.6	3.7	1.2	
0.45	14.4	8.1	22.5	6.0	2.1	11.7	6.8	18.5	5.1	1.8	10.8	6.3	17.1	4.5	1.6	11.7	5.9	17.6	4.2	1.5	
0.50	16.0	9.0	25.0	6.7	2.6	13.0	7.5	20.5	5.7	2.2	12.0	7.0	19.0	5.0	1.9	13.0	6.5	19.5	4.7	1.8	
0.55	17.6	9.9	27.5	7.3	3.0	14.3	8.3	22.6	6.2	2.6	13.2	7.7	20.9	5.5	2.3	14.3	7.2	21.5	5.1	2.1	
0.60	19.2	10.8	30.0	8.0	3.5	15.6	9.0	24.6	6.8	3.0	14.4	8.4	22.8	6.0	2.6	15.6	7.8	23.4	5.6	2.4	
0.65	20.8	11.7	32.5	8.7	3.9	16.9	9.8	26.7	7.4	3.3	15.6	9.1	24.7	6.5	2.9	16.9	8.5	25.4	6.1	2.7	
0.70	22.4	12.6	35.0	9.3	4.4	18.2	10.5	28.7	7.9	3.7	16.8	9.8	26.6	7.0	3.3	18.2	9.1	27.3	6.5	3.1	
0.75	24.0	13.5	37.5	10.0	4.8	19.5	11.3	30.8	8.5	4.1	18.0	10.5	28.5	7.5	3.6	19.5	9.8	29.3	7.0	3.4	
0.80	25.6	14.4	40.0	10.7	5.3	20.8	12.0	32.8	9.1	4.5	19.2	11.2	30.4	8.0	4.0	20.8	10.4	31.2	7.5	3.7	
0.85	27.2	15.3	42.5	11.3	5.8	22.1	12.8	34.9	9.6	4.9	20.4	11.9	32.3	8.5	4.3	22.1	11.1	33.2	7.9	4.0	
0.90	28.8	16.2	45.0	12.0	6.2	23.4	13.5	36.9	10.2	5.3	21.6	12.6	34.2	9.0	4.7	23.4	11.7	35.1	8.4	4.3	
0.95	30.4	17.1	47.5	12.7	6.7	24.7	14.3	39.0	10.8	5.7	22.8	13.3	36.1	9.5	5.0	24.7	12.4	37.1	8.9	4.7	
1.00	32.0	18.0	50.0	13.3	7.1	26.0	15.0	41.0	11.3	6.1	24.0	14.0	38.0	10.0	5.3	26.0	13.0	39.0	9.3	5.0	
1.05	33.6	18.9	52.5	14.0	7.6	27.3	15.8	43.1	11.9	6.4	25.2	14.7	39.9	10.5	5.7	27.3	13.7	41.0	9.8	5.3	
1.10	35.2	19.8	55.0	14.7	8.0	28.6	16.5	45.1	12.5	6.8	26.4	15.4	41.8	11.0	6.0	28.6	14.3	42.9	10.3	5.6	
1.15	36.8	20.7	57.5	15.3	8.5	29.9	17.3	47.2	13.0	7.2	27.6	16.1	43.7	11.5	6.4	29.9	15.0	44.9	10.7	5.9	
1.20	38.4	21.6	60.0	16.0	8.9	31.2	18.0	49.2	13.6	7.6	28.8	16.8	45.6	12.0	6.7	31.2	15.6	46.8	11.2	6.3	
1.25	40.0	22.5	62.5	16.7	9.4	32.5	18.8	51.3	14.2	8.0	30.0	17.5	47.5	12.5	7.1	32.5	16.3	48.8	11.7	6.6	
1.30	41.6	23.4	65.0	17.3	9.9	33.8	19.5	53.3	14.7	8.4	31.2	18.2	49.4	13.0	7.4	33.8	16.9	50.7	12.1	6.9	
1.35	43.2	24.3	67.5	18.0	10.3	35.1	20.3	55.4	15.3	8.8	32.4	18.9	51.3	13.5	7.7	35.1	17.6	52.7	12.6	7.2	
1.40	44.8	25.2	70.0	18.7	10.8	36.4	21.0	57.4	15.9	9.2	33.6	19.6	53.2	14.0	8.1	36.4	18.2	54.6	13.1	7.5	

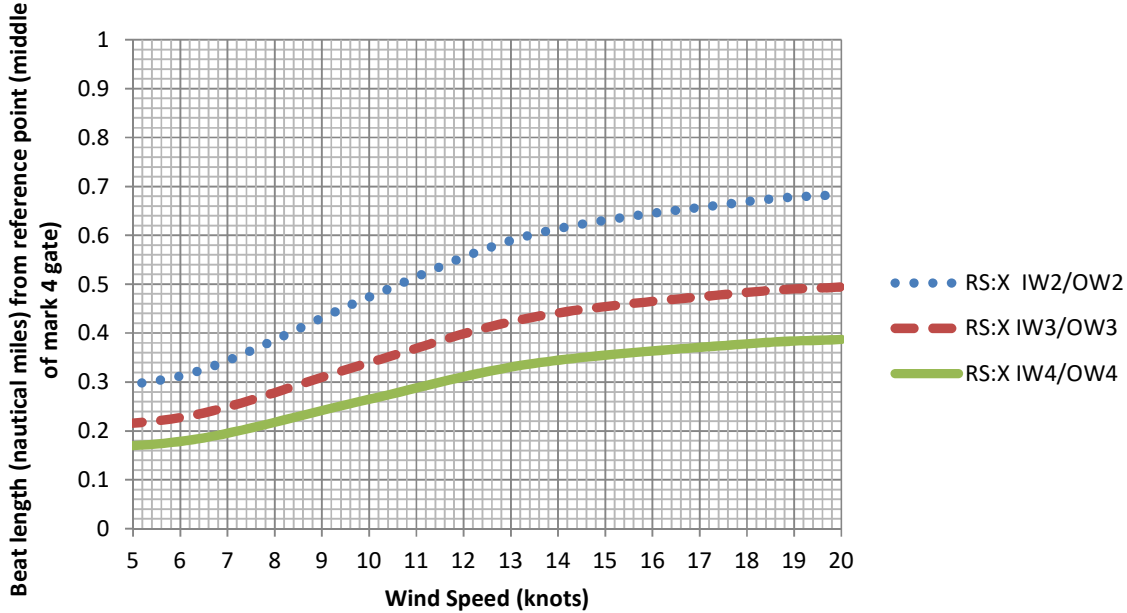
Time from Start to Reference (0.05NM) and Reference to Finish (0.05 NM (Downwind finish))											
0.05	1.6	0.9		1.3	0.8		1.2	0.7		1.3	0.7
Time for reaching leg from gate to finish of 0.15 NM											
0.15			3			2.55			2.25		2.1

RS:X - Trapezoid, target time 25 minutes.



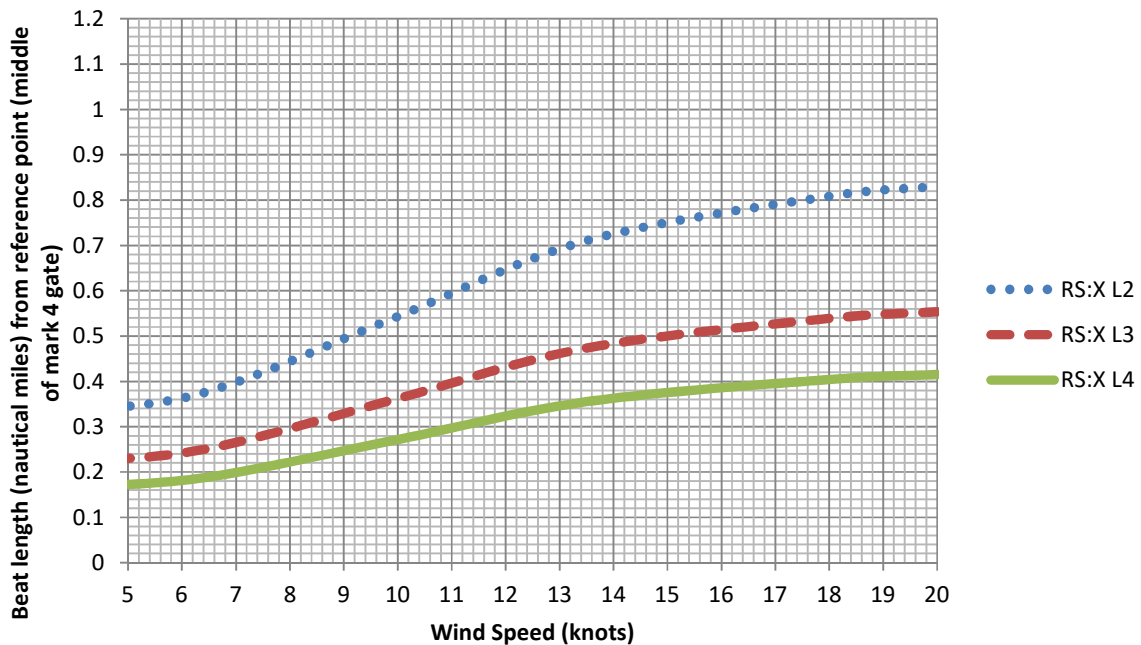
Anticipated leg times for RS:X Trapezoid with a race target time 25 minutes																			
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+	
Average beat		0.33		0.51		0.67		0.75		Average beat		0.33		0.51		0.67		0.75	
12		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	02		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	6.9	6.9	7.8	7.8	8.6	8.6	8.8	8.8		Start to 1	6.9	6.9	7.8	7.8	8.6	8.6	8.8	8.8
	1 to 4	4.3	11.3	4.1	11.9	3.3	11.9	3.0	11.8		1 to 2	2.0	8.9	1.4	9.2	1.3	9.9	1.5	10.3
	4 to 1	6.0	17.3	7.1	19.0	8.0	19.9	8.3	20.1		2 to 3	4.3	13.3	4.1	13.2	3.3	13.2	3.0	13.3
	1 to 2	2.0	19.3	1.4	20.3	1.3	21.2	1.5	21.6		3 to 2	6.0	19.3	7.1	20.3	8.0	21.2	8.3	21.6
	2 to 3	4.3	23.7	4.1	24.4	3.3	24.6	3.0	24.6		2 to 3	4.3	23.7	4.1	24.4	3.3	24.6	3.0	24.6
	3 to Finish	1.4	25.0	0.6	25.0	0.5	25.0	0.5	25.0		3 to Finish	1.4	25.0	0.6	25.0	0.5	25.0	0.5	25.0
	Average beat	0.33		0.51		0.67		0.75			Average beat	0.33		0.51		0.67		0.75	
13		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	03		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	5.0	5.0	5.5	5.5	6.0	6.0	6.2	6.2		Start to 1	5.0	5.0	5.5	5.5	6.0	6.0	6.2	6.2
	1 to 4	3.0	8.0	2.8	8.3	2.3	8.3	2.0	8.2		1 to 2	1.4	6.4	0.9	6.5	0.9	6.9	1.0	7.2
	4 to 1	4.1	12.2	4.8	13.1	5.4	13.7	5.6	13.8		2 to 3	3.0	9.4	2.8	9.2	2.3	9.2	2.0	9.2
	1 to 4	3.0	15.1	2.8	15.9	2.3	16.0	2.0	15.9		3 to 2	4.1	13.5	4.8	14.0	5.4	14.6	5.6	14.8
	4 to 1	4.1	19.3	4.8	20.7	5.4	21.4	5.6	21.5		2 to 3	3.0	16.5	2.8	16.8	2.3	16.9	2.0	16.9
	1 to 2	1.4	20.7	0.9	21.6	0.9	22.3	1.0	22.5		3 to 2	4.1	20.7	4.8	21.6	5.4	22.3	5.6	22.5
	2 to 3	3.0	23.7	2.8	24.4	2.3	24.6	2.0	24.6		2 to 3	3.0	23.7	2.8	24.4	2.3	24.6	2.0	24.6
3 to Finish	1.4	25.0	0.6	25.0	0.5	25.0	0.5	25.0	3 to Finish	1.4	25.0	0.6	25.0	0.5	25.0	0.5	25.0		
Average beat	0.23		0.35		0.45		0.51		Average beat	0.23		0.35		0.45		0.51			
14		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	04		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	4.1	4.1	4.4	4.4	4.7	4.7	4.8	4.8		Start to 1	4.1	4.1	4.4	4.4	4.7	4.7	4.8	4.8
	1 to 4	2.3	6.3	2.1	6.5	1.7	6.4	1.5	6.4		1 to 2	1.1	5.1	0.7	5.1	0.7	5.4	0.8	5.6
	4 to 1	3.2	9.5	3.7	10.1	4.1	10.5	4.3	10.6		2 to 3	2.3	7.4	2.1	7.1	1.7	7.1	1.5	7.1
	1 to 4	2.3	11.8	2.1	12.2	1.7	12.2	1.5	12.2		3 to 2	3.2	10.5	3.7	10.8	4.1	11.2	4.3	11.4
	4 to 1	3.2	14.9	3.7	15.9	4.1	16.3	4.3	16.4		2 to 3	2.3	12.8	2.1	12.9	1.7	12.9	1.5	12.9
	1 to 4	2.3	17.2	2.1	18.0	1.7	18.0	1.5	18.0		3 to 2	3.2	16.0	3.7	16.6	4.1	17.0	4.3	17.2
	4 to 1	3.2	20.3	3.7	21.6	4.1	22.2	4.3	22.2		2 to 3	2.3	18.2	2.1	18.6	1.7	18.7	1.5	18.7
1 to 2	1.1	21.4	0.7	22.3	0.7	22.8	0.8	23.0	3 to 2	3.2	21.4	3.7	22.3	4.1	22.8	4.3	23.0		
2 to 3	2.3	23.7	2.1	24.4	1.7	24.6	1.5	24.6	2 to 3	2.3	23.7	2.1	24.4	1.7	24.6	1.5	24.6		
3 to Finish	1.4	25.0	0.6	25.0	0.5	25.0	0.5	25.0	3 to Finish	1.4	25.0	0.6	25.0	0.5	25.0	0.5	25.0		
Average beat	0.18		0.26		0.34		0.39		Average beat	0.18		0.26		0.34		0.39			

RS:X - Trapezoid with beat to finish, target time 25 minutes.



Anticipated leg times for RS:X Trapezoid with beat to finish with a race target time 25 minutes																					
Wind Range		5 - 8		8 - 12		12-15		15+		Wind Range		5 - 8		8 - 12		12-15		15+			
Average beat		0.32		0.46		0.59		0.65		Average beat		0.32		0.46		0.59		0.65			
12		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	02		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	6.6	6.6	7.2	7.2	7.7	7.7	7.8	7.8		Start to 1	6.6	6.6	7.2	7.2	7.7	7.7	7.8	7.8	7.8	7.8
	1 to 4	4.1	10.7	3.7	10.8	2.9	10.6	2.6	10.4		1 to 2	1.9	8.5	1.2	8.4	1.2	8.8	1.3	9.1	1.3	9.1
	4 to 1	5.7	16.3	6.5	17.3	7.1	17.7	7.2	17.6		2 to 3	4.1	12.6	3.7	12.1	2.9	11.8	2.6	11.7	2.6	11.7
	1 to 2	1.9	18.2	1.2	18.5	1.2	18.9	1.3	18.9		3 to 2	5.7	18.2	6.5	18.5	7.1	18.9	7.2	18.9	7.2	18.9
	2 to 3	4.1	22.3	3.7	22.2	2.9	21.8	2.6	21.5		2 to 3	4.1	22.3	3.7	22.2	2.9	21.8	2.6	21.5	2.6	21.5
	3 to 5	1.9	24.2	1.2	23.5	1.2	23.0	1.3	22.8		3 to 5	1.9	24.2	1.2	23.5	1.2	23.0	1.3	22.8	1.3	22.8
	5 to Finish	0.8	25.0	1.5	25.0	2.0	25.0	2.2	25.0		5 to Finish	0.8	25.0	1.5	25.0	2.0	25.0	2.2	25.0	2.2	25.0
13		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	03		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	5.0	5.0	5.3	5.3	5.7	5.7	5.8	5.8		Start to 1	5.0	5.0	5.3	5.3	5.7	5.7	5.8	5.8	5.8	5.8
	1 to 4	3.0	8.0	2.6	8.0	2.1	7.8	1.9	7.6		1 to 2	1.4	6.4	0.9	6.2	0.8	6.5	0.9	6.7	0.9	6.7
	4 to 1	4.1	12.1	4.6	12.6	5.1	12.9	5.2	12.8		2 to 3	3.0	9.4	2.6	8.9	2.1	8.6	1.9	8.6	1.9	8.6
	1 to 4	3.0	15.1	2.6	15.3	2.1	15.0	1.9	14.7		3 to 2	4.1	13.5	4.6	13.5	5.1	13.7	5.2	13.8	5.2	13.8
	4 to 1	4.1	19.2	4.6	19.9	5.1	20.1	5.2	19.9		2 to 3	3.0	16.5	2.6	16.1	2.1	15.8	1.9	15.7	1.9	15.7
	1 to 2	1.4	20.6	0.9	20.8	0.8	20.9	0.9	20.9		3 to 2	4.1	20.6	4.6	20.8	5.1	20.9	5.2	20.9	5.2	20.9
	2 to 3	3.0	23.5	2.6	23.4	2.1	23.0	1.9	22.8		2 to 3	3.0	23.5	2.6	23.4	2.1	23.0	1.9	22.8	1.9	22.8
3 to 5	1.4	24.9	0.9	24.3	0.8	23.9	0.9	23.7	3 to 5	1.4	24.9	0.9	24.3	0.8	23.9	0.9	23.7	0.9	23.7		
5 to Finish	0.1	25.0	0.7	25.0	1.1	25.0	1.3	25.0	5 to Finish	0.1	25.0	0.7	25.0	1.1	25.0	1.3	25.0	1.3	25.0		
14		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total	04		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total		
	Start to 1	4.1	4.1	4.3	4.3	4.6	4.6	4.6	4.6		Start to 1	4.1	4.1	4.3	4.3	4.6	4.6	4.6	4.6	4.6	4.6
	1 to 4	2.3	6.5	2.1	6.4	1.7	6.2	1.5	6.1		1 to 2	1.1	5.2	0.7	5.0	0.7	5.2	0.7	5.4	0.7	5.4
	4 to 1	3.2	9.7	3.6	10.0	4.0	10.2	4.1	10.2		2 to 3	2.3	7.5	2.1	7.1	1.7	6.9	1.5	6.8	1.5	6.8
	1 to 4	2.3	12.0	2.1	12.0	1.7	11.8	1.5	11.7		3 to 2	3.2	10.8	3.6	10.7	4.0	10.8	4.1	10.9	4.1	10.9
	4 to 1	3.2	15.3	3.6	15.6	4.0	15.8	4.1	15.7		2 to 3	2.3	13.1	2.1	12.7	1.7	12.5	1.5	12.4	1.5	12.4
	1 to 4	2.3	17.6	2.1	17.7	1.7	17.5	1.5	17.2		3 to 2	3.2	16.3	3.6	16.3	4.0	16.5	4.1	16.5	4.1	16.5
	4 to 1	3.2	20.8	3.6	21.3	4.0	21.4	4.1	21.3		2 to 3	2.3	18.7	2.1	18.4	1.7	18.1	1.5	17.9	1.5	17.9
1 to 2	1.1	21.9	0.7	22.0	0.7	22.1	0.7	22.0	3 to 2	3.2	21.9	3.6	22.0	4.0	22.1	4.1	22.0	4.1	22.0		
2 to 3	2.3	24.2	2.1	24.1	1.7	23.7	1.5	23.5	2 to 3	2.3	24.2	2.1	24.1	1.7	23.7	1.5	23.5	1.5	23.5		
3 to 5	1.1	25.3	0.7	24.8	0.7	24.4	0.7	24.2	3 to 5	1.1	25.3	0.7	24.8	0.7	24.4	0.7	24.2	0.7	24.2		
5 to Finish	-0.3	25.0	0.2	25.0	0.6	25.0	0.8	25.0	5 to Finish	-0.3	25.0	0.2	25.0	0.6	25.0	0.8	25.0	0.8	25.0		

RS:X - Leeward, target time 25 minutes.



Anticipated leg times for RS:X Leeward with race target time of 25 minutes									
Wind Range		5 - 8		8 - 12		12-15		15+	
L2	Leg Length	0.38		0.54		0.71		0.81	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	7.7	7.7	8.3	8.3	9.1	9.1	9.4	9.4
	1 to 4	4.9	12.6	4.3	12.7	3.6	12.7	3.2	12.7
	4 to 1	6.8	19.4	7.6	20.3	8.5	21.2	8.9	21.6
	1 to Finish	5.6	25.0	4.7	25.0	3.8	25.0	3.4	25.0
L3	Leg Length	0.25		0.36		0.47		0.54	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	5.4	5.4	5.8	5.8	6.3	6.3	6.5	6.5
	1 to 4	3.3	8.7	2.9	8.7	2.4	8.7	2.2	8.6
	4 to 1	4.5	13.3	5.1	13.7	5.7	14.3	5.9	14.6
	1 to 4	3.3	16.5	2.9	16.6	2.4	16.7	2.2	16.7
	4 to 1	4.5	21.1	5.1	21.7	5.7	22.4	5.9	22.6
1 to Finish	3.9	25.0	3.3	25.0	2.6	25.0	2.4	25.0	
L4	Leg Length	0.19		0.27		0.36		0.40	
		Leg time	Total	Leg time	Total	Leg time	Total	Leg time	Total
	Start to 1	4.3	4.3	4.5	4.5	4.9	4.9	5.0	5.0
	1 to 4	2.5	6.8	2.2	6.7	1.8	6.6	1.6	6.6
	4 to 1	3.4	10.2	3.8	10.5	4.3	10.9	4.4	11.1
	1 to 4	2.5	12.6	2.2	12.7	1.8	12.7	1.6	12.7
	4 to 1	3.4	16.0	3.8	16.5	4.3	16.9	4.4	17.1
	1 to 4	2.5	18.5	2.2	18.6	1.8	18.7	1.6	18.7
	4 to 1	3.4	21.9	3.8	22.4	4.3	23.0	4.4	23.2
1 to Finish	3.1	25.0	2.6	25.0	2.0	25.0	1.8	25.0	

RS:X 70° 110° Trapezoid with beat to finish (finish 0.05 below the starting line)																				
Wind Range	5 - 8 Knots					8 - 12 Knots					12 - 15 Knots					15+ Knots				
Upwind speed	18 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	14 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	12 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)	11 min/mile			One Reach time 2/3 beat	Finish leg time (5 - F)
Run Speed	13 min/mile					8 min/mile					5 min/mile					4 min/mile				
Reach speed	9 min/mile					4 min/mile					3 min/mile					3 min/mile				
Beat length Nautical Miles (Ref to 1)	Up time	Down time	Up and Down			Up time	Down time	Up and Down			Up time	Down time	Up and Down			Up time	Down time	Up and Down		
0.30	5.4	3.9	9.3	1.8	0.3	4.2	2.4	6.6	0.8	0.1	3.6	1.5	5.1	0.6	0.1	3.3	1.2	4.5	0.6	0.1
0.35	6.3	4.6	10.9	2.1	0.5	4.9	2.8	7.7	0.9	0.2	4.2	1.8	6.0	0.7	0.2	3.9	1.4	5.3	0.7	0.2
0.40	7.2	5.2	12.4	2.4	0.7	5.6	3.2	8.8	1.1	0.3	4.8	2.0	6.8	0.8	0.2	4.4	1.6	6.0	0.8	0.2
0.45	8.1	5.9	14.0	2.7	0.9	6.3	3.6	9.9	1.2	0.4	5.4	2.3	7.7	0.9	0.3	5.0	1.8	6.8	0.9	0.3
0.50	9.0	6.5	15.5	3.0	1.2	7.0	4.0	11.0	1.3	0.5	6.0	2.5	8.5	1.0	0.4	5.5	2.0	7.5	1.0	0.4
0.55	9.9	7.2	17.1	3.3	1.4	7.7	4.4	12.1	1.5	0.6	6.6	2.8	9.4	1.1	0.5	6.1	2.2	8.3	1.1	0.5
0.60	10.8	7.8	18.6	3.6	1.6	8.4	4.8	13.2	1.6	0.7	7.2	3.0	10.2	1.2	0.5	6.6	2.4	9.0	1.2	0.5
0.65	11.7	8.5	20.2	3.9	1.8	9.1	5.2	14.3	1.7	0.8	7.8	3.3	11.1	1.3	0.6	7.2	2.6	9.8	1.3	0.6
0.70	12.6	9.1	21.7	4.2	2.0	9.8	5.6	15.4	1.9	0.9	8.4	3.5	11.9	1.4	0.7	7.7	2.8	10.5	1.4	0.7
0.75	13.5	9.8	23.3	4.5	2.2	10.5	6.0	16.5	2.0	1.0	9.0	3.8	12.8	1.5	0.7	8.3	3.0	11.3	1.5	0.7
0.80	14.4	10.4	24.8	4.8	2.4	11.2	6.4	17.6	2.1	1.1	9.6	4.0	13.6	1.6	0.8	8.8	3.2	12.0	1.6	0.8
0.85	15.3	11.1	26.4	5.1	2.6	11.9	6.8	18.7	2.3	1.2	10.2	4.3	14.5	1.7	0.9	9.4	3.4	12.8	1.7	0.9
0.90	16.2	11.7	27.9	5.4	2.8	12.6	7.2	19.8	2.4	1.2	10.8	4.5	15.3	1.8	0.9	9.9	3.6	13.5	1.8	0.9
0.95	17.1	12.4	29.5	5.7	3.0	13.3	7.6	20.9	2.5	1.3	11.4	4.8	16.2	1.9	1.0	10.5	3.8	14.3	1.9	1.0
1.00	18.0	13.0	31.0	6.0	3.2	14.0	8.0	22.0	2.7	1.4	12.0	5.0	17.0	2.0	1.1	11.0	4.0	15.0	2.0	1.1
1.05	18.9	13.7	32.6	6.3	3.4	14.7	8.4	23.1	2.8	1.5	12.6	5.3	17.9	2.1	1.1	11.6	4.2	15.8	2.1	1.1
1.10	19.8	14.3	34.1	6.6	3.6	15.4	8.8	24.2	2.9	1.6	13.2	5.5	18.7	2.2	1.2	12.1	4.4	16.5	2.2	1.2
1.15	20.7	15.0	35.7	6.9	3.8	16.1	9.2	25.3	3.1	1.7	13.8	5.8	19.6	2.3	1.3	12.7	4.6	17.3	2.3	1.3
1.20	21.6	15.6	37.2	7.2	4.0	16.8	9.6	26.4	3.2	1.8	14.4	6.0	20.4	2.4	1.3	13.2	4.8	18.0	2.4	1.3
1.25	22.5	16.3	38.8	7.5	4.2	17.5	10.0	27.5	3.3	1.9	15.0	6.3	21.3	2.5	1.4	13.8	5.0	18.8	2.5	1.4
1.30	23.4	16.9	40.3	7.8	4.4	18.2	10.4	28.6	3.5	2.0	15.6	6.5	22.1	2.6	1.5	14.3	5.2	19.5	2.6	1.5
1.35	24.3	17.6	41.9	8.1	4.6	18.9	10.8	29.7	3.6	2.1	16.2	6.8	23.0	2.7	1.5	14.9	5.4	20.3	2.7	1.5
1.40	25.2	18.2	43.4	8.4	4.8	19.6	11.2	30.8	3.7	2.2	16.8	7.0	23.8	2.8	1.6	15.4	5.6	21.0	2.8	1.6

Time from Start to Reference (0.05NM) and Reference to Finish (0.05 NM (Downwind finish))											
0.05	0.9	0.7		0.7	0.4		0.6	0.3		0.6	0.2
Time for reaching leg from gate to finish of 0.15 NM											
0.15			1.35			0.6			0.45		0.5

ILLUSTRATING THE COURSE

Course designations:

I	inner trapezoid, reaching finish
O	outer trapezoid reaching finish
IW	inner trapezoid with beat to finish
OW	outer trapezoid with beat to finish
L	windward/leeward finishing to leeward
W	windward/leeward finishing to windward
LG	windward/leeward with a reaching finish to starboard following a leeward leg
LR	windward/leeward with a reaching finish to port following a leeward leg
WG	windward/leeward with a reaching finish to starboard following a windward leg
WR	windward/leeward with a reaching finish to port following a windward leg
T	Triangular with start finish in middle of the beat
TL	triangular with leeward finish
TW	triangular with windward finish
TR	triangular with reaching finish
IA, IWA, LA, WA, TLA, TWA, TRA	Mark 1 has a corresponding offset mark 1a
IS, OS and LS	mean the designated trapezoid or windward/leeward with a slalom finish.
M	windward/leeward, finishing to leeward, marks to starboard, for match racing.
IOD	Optimist course

Other course diagram standards:

The number following the course designation indicates the number of beats (windward legs) to be sailed.

An offset mark following Mark 1 is designated Mark 1a set approximately 60 m at 80° – 90° off the wind. For fleet racing courses, gates are designated 3s, 3p, and 4s, 4p, depending on the course. 3s and 4s are the gate marks a boat will leave to starboard; 3p and 4p are the marks a boat will leave to port.

The gate on Course L or W is designated 4s and 4p.

Course M uses Mark 1 for the windward mark and Mark 2 for the leeward mark.

Starting marks are labeled SS (Starting mark starboard end), SP (Starting mark port end)

Finishing marks are labeled FS (Finishing mark starboard end), FP (Finishing mark port end)

Marks should be described by size (large, small), colour and shape (tetrahedral, spherical, cylindrical or conical).

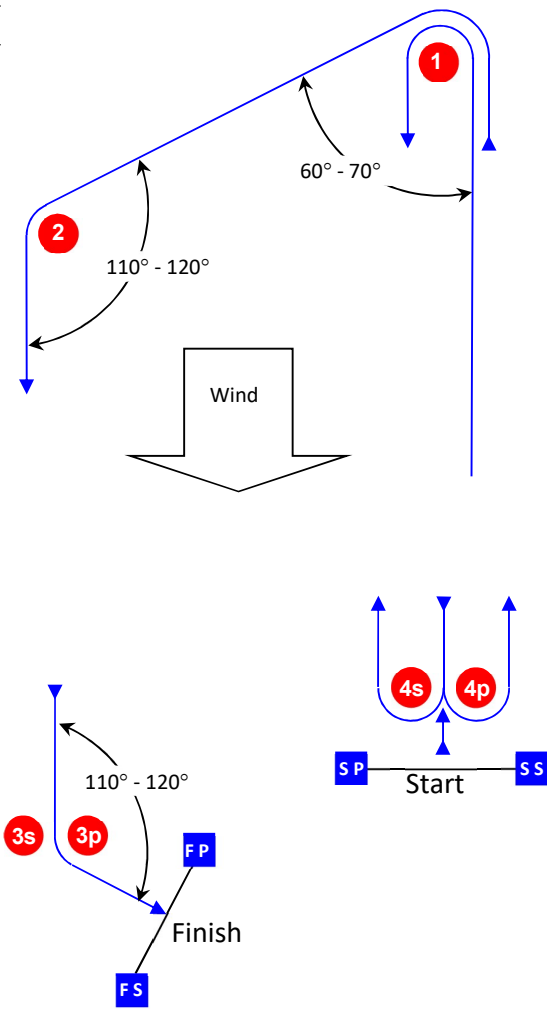
When a mark of a gate is used before a reaching leg, only the mark being rounded should be specified in the course description. E.g. the mark before the finish in an I or O course is 3p. The other mark (3s) is not a mark of the course even though it may still be laid.

The interior angles of a trapezoid course should be approximately 70°, 110° for non spinnaker boats and 60°, 120° for boats carrying spinnakers.

A slalom should take approximately 2 minutes. The angles between slalom marks should be 15° - 20° (100° off the wind from the gate to S1).

Course Illustration – Trapezoid

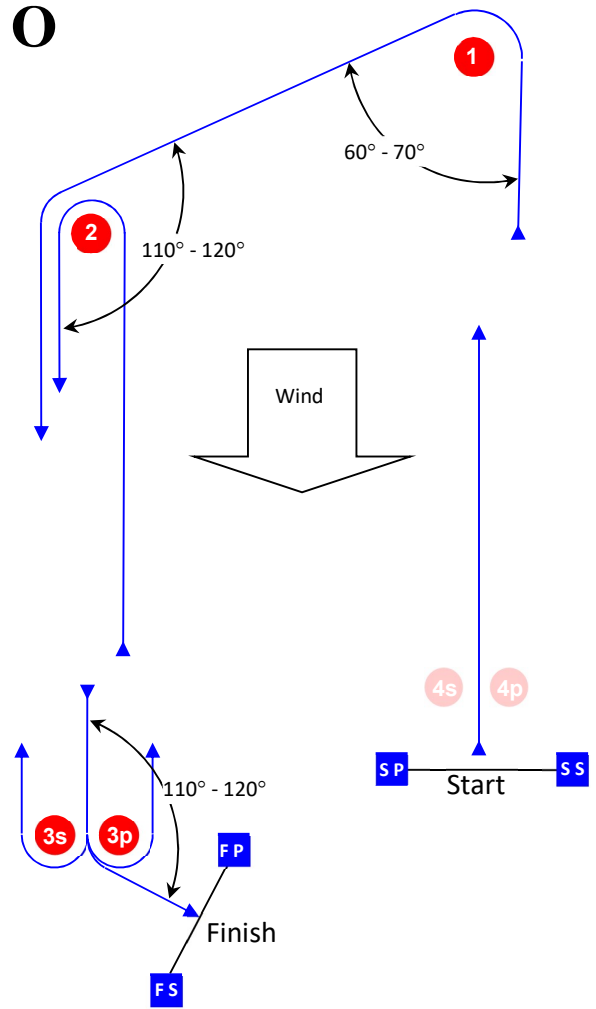
I



Course: Inner Trapezoid

Signal	Mark Rounding Order
I2	Start – 1 – 4s/4p – 1 – 2 – 3p – Finish
I3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
I4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish

O



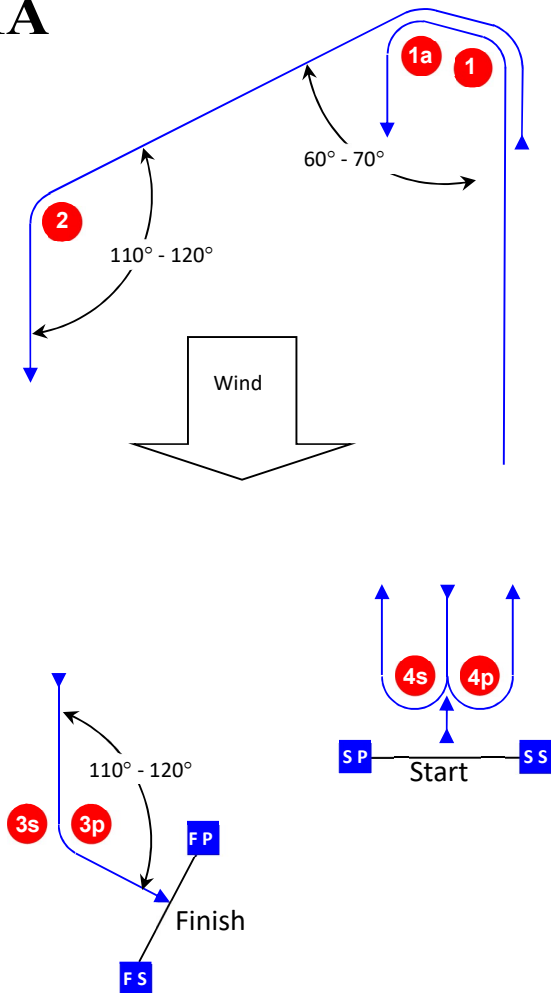
Course: Outer Trapezoid

Signal	Mark Rounding Order
O2	Start – 1 – 2 – 3s/3p – 2 – 3p – Finish
O3	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish
O4	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish

Mark	Description
1 2	
3s 3p	
4s 4p	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Trapezoid with offset mark

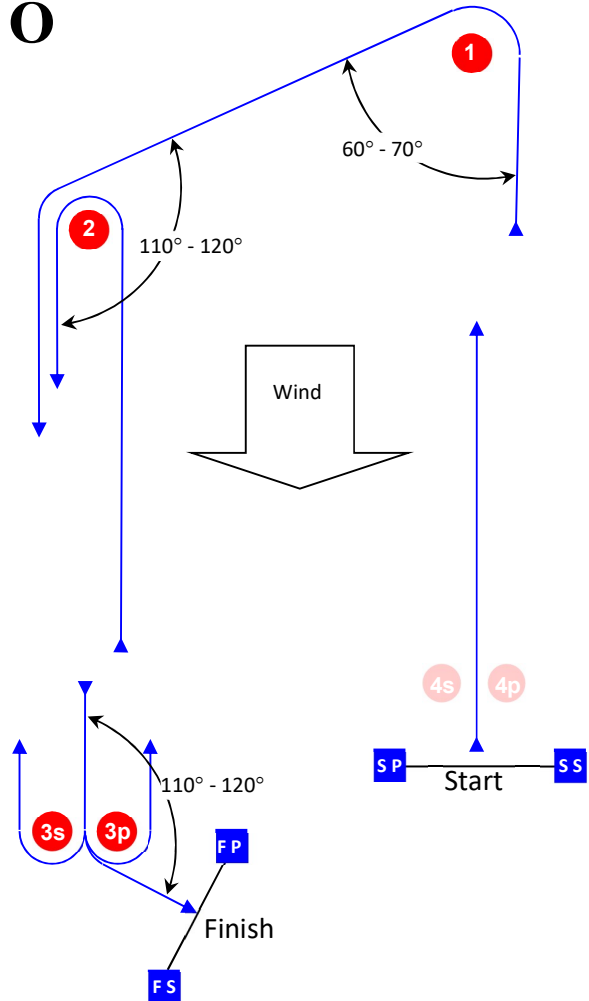
IA



Course: Inner Trapezoid

Signal	Mark Rounding Order
IA2	Start – 1 – 1a – 4s/4p – 1 – 1a – 2 – 3p – Finish
IA3	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 2 – 3p – Finish
IA4	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 2 – 3p – Finish

O



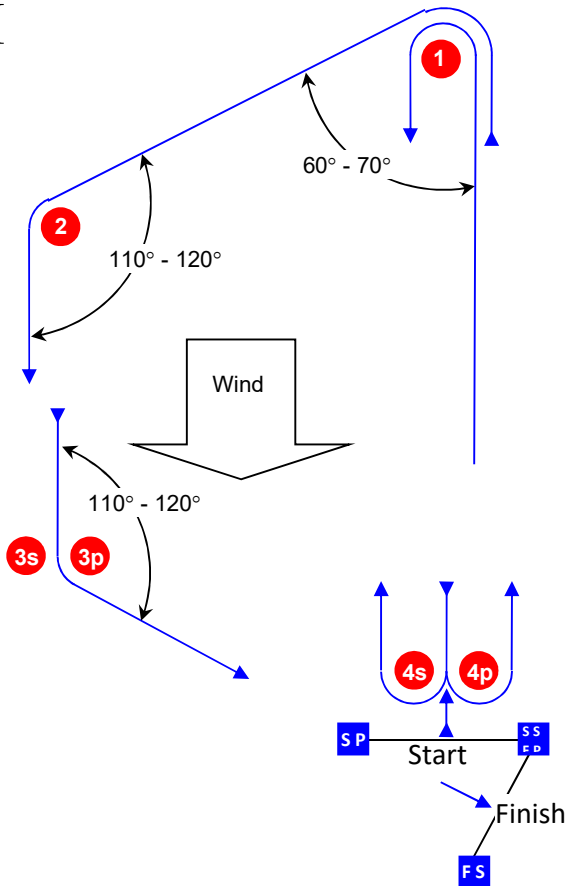
Course: Outer Trapezoid

Signal	Mark Rounding Order
02	Start – 1 – 2 – 3s/3p – 2 – 3p – Finish
03	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish
04	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish

Mark	Description
1 2	
1a	
3s 3p	
4s 4p	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Trapezoid with signal boat for start and finish

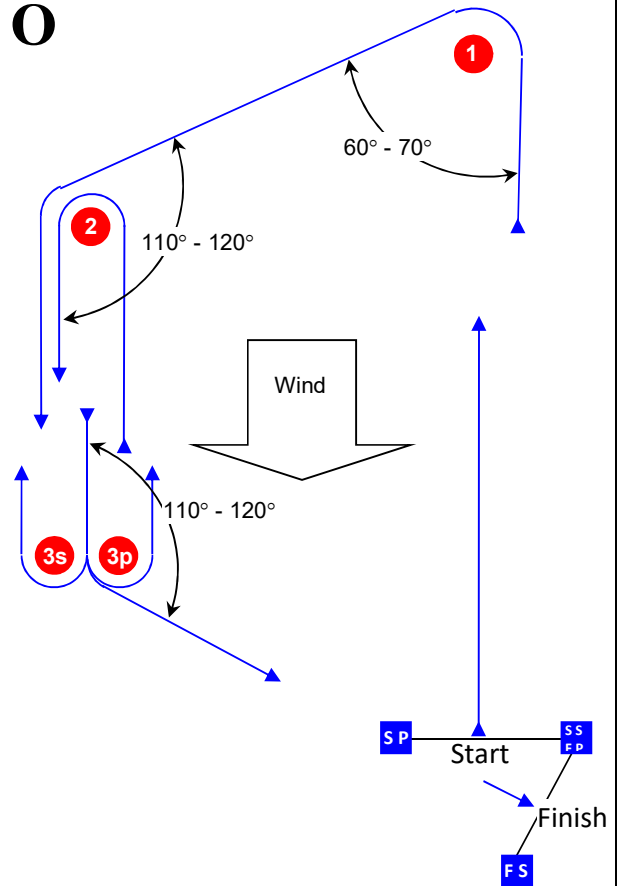
I



Course: Inner Trapezoid

Signal	Mark Rounding Order
I2	Start – 1 – 4s/4p – 1 – 2 – 3p – Finish
I3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
I4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish

O



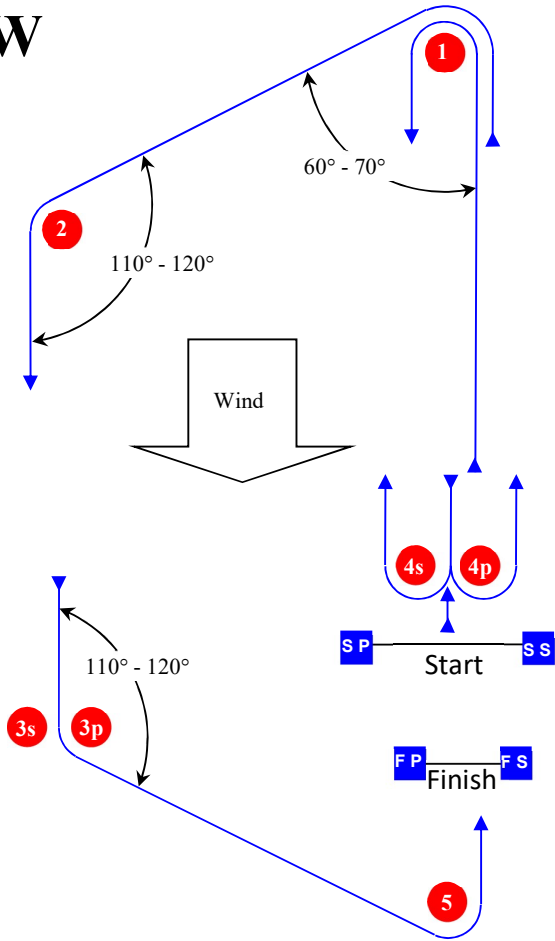
Course: Outer Trapezoid

Signal	Mark Rounding Order
O2	Start – 1 – 2 – 3s/3p – 2 – 3p – Finish
O3	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish
O4	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish

Mark	Description
1 2	
3s 3p	
4s 4p	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Trapezoid with beat to finish - separate finish

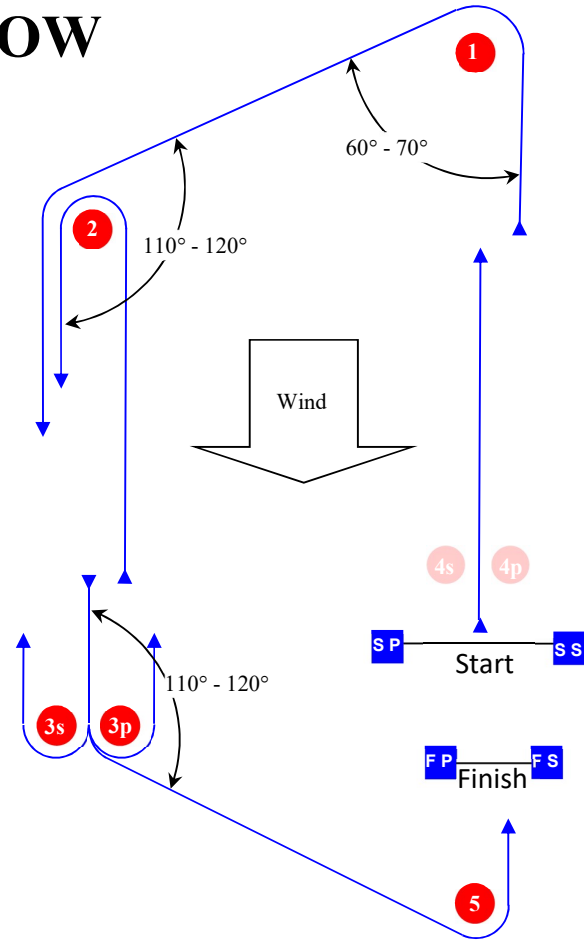
IW



Course: Inner Trapezoid with beat to finish

Signal	Mark Rounding Order
IW1	Start – 1 – 2 – 3p – 5 – Finish
IW2	Start – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish

OW



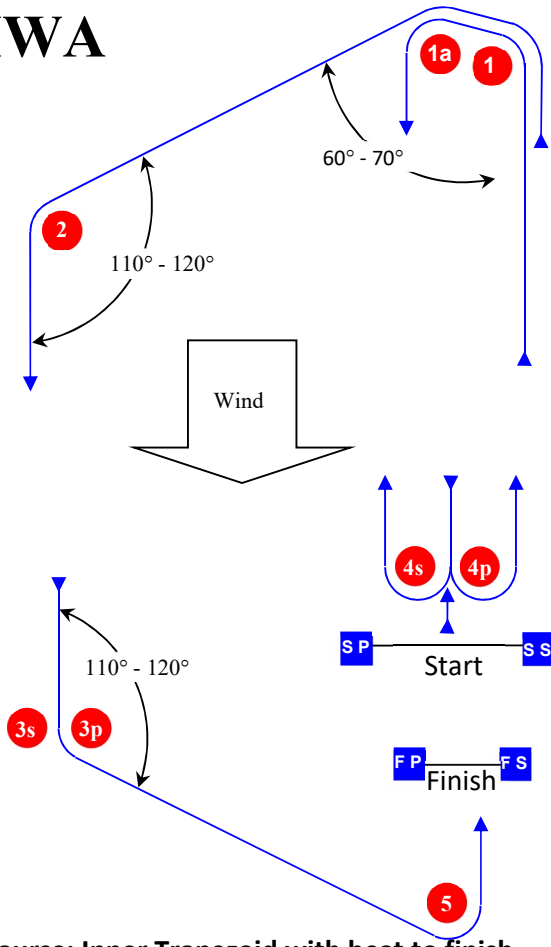
Course: Outer Trapezoid with beat to finish

Signal	Mark Rounding Order
OW2	Start – 1 – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW3	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW4	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish

Mark	Description
1 2	
3s 3p	
4s 4p	
5	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Trapezoid with beat to finish, offset mark and separate finish

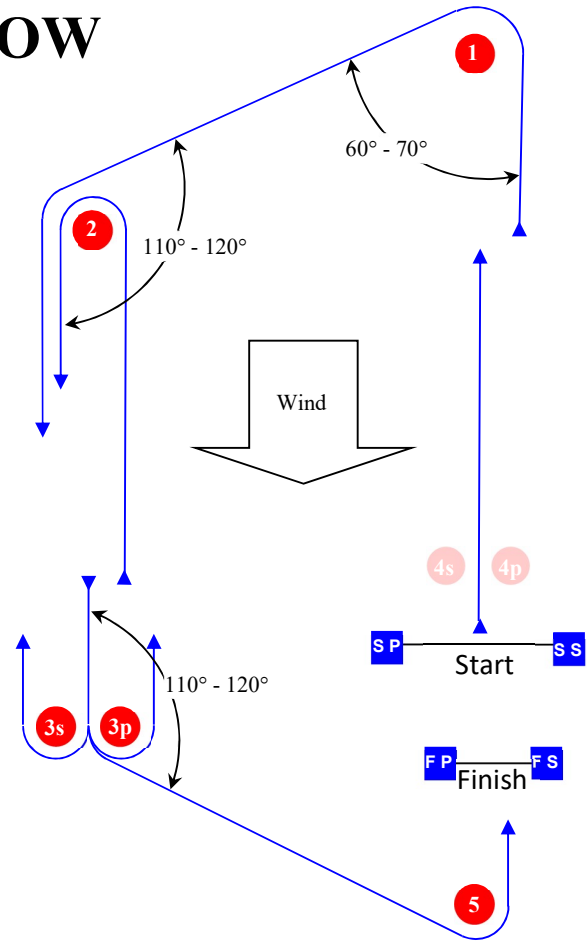
IWA



Course: Inner Trapezoid with beat to finish

Signal	Mark Rounding Order
IWA1	Start – 1 – 1a – 2 – 3p – 5 – Finish
IWA2	Start – 1 – 1a – 4s/4p – 1 – 1a – 2 – 3p – 5 – Finish
IWA3	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 2 – 3p – 5 – Finish
IWA4	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 2 – 3p – 5 – Finish

OW

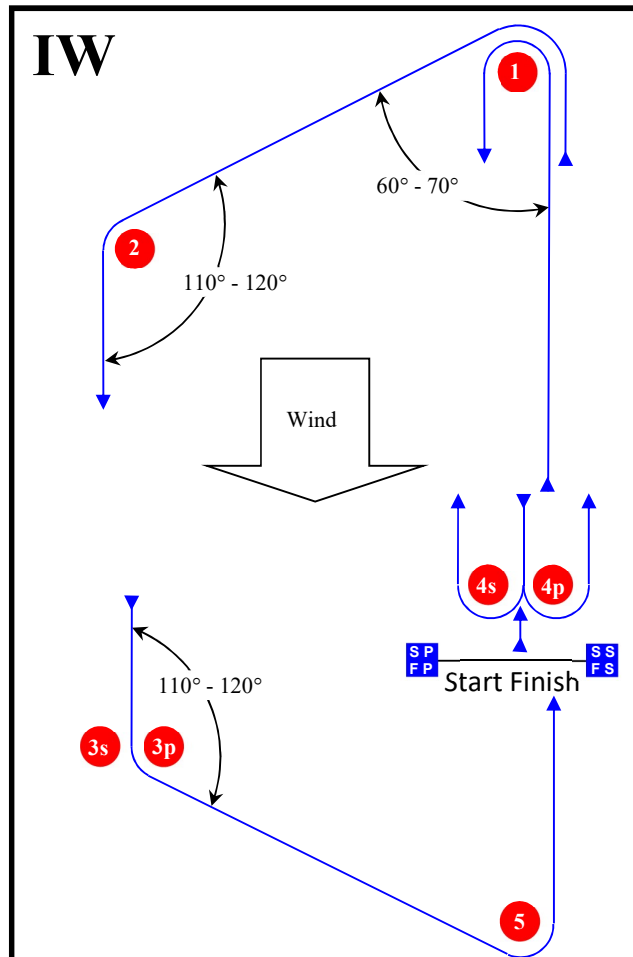


Course: Outer Trapezoid with beat to finish

Signal	Mark Rounding Order
OW2	Start – 1 – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW3	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW4	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish

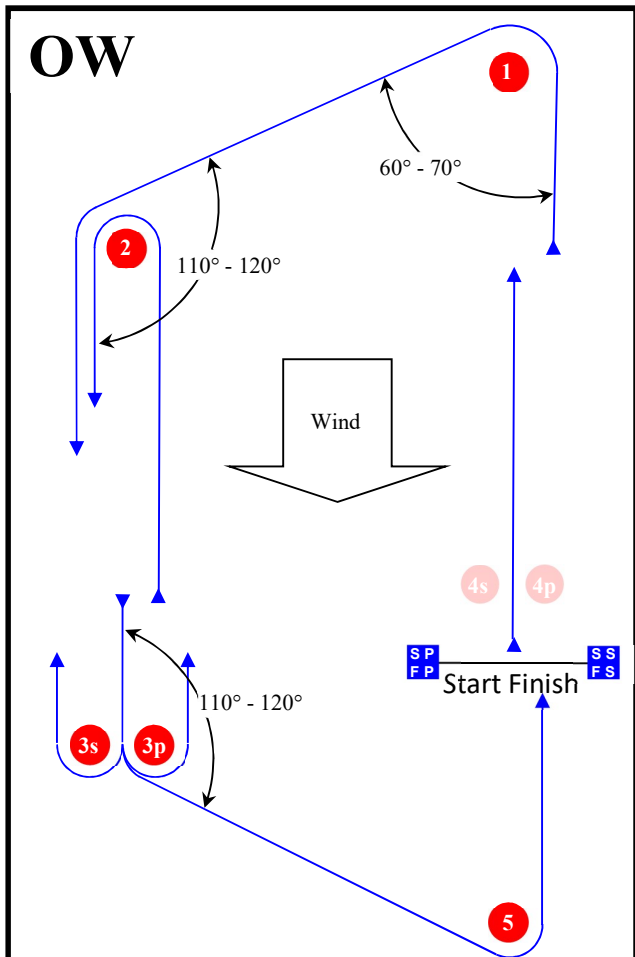
Mark	Description
1 2	
1a	
3s 3p	
4s 4p	
5	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Trapezoid with beat to finish - signal boat for start/finish



Course: Inner Trapezoid with beat to finish

Signal	Mark Rounding Order
IW1	Start – 1 – 2 – 3p – 5 – Finish
IW2	Start – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish



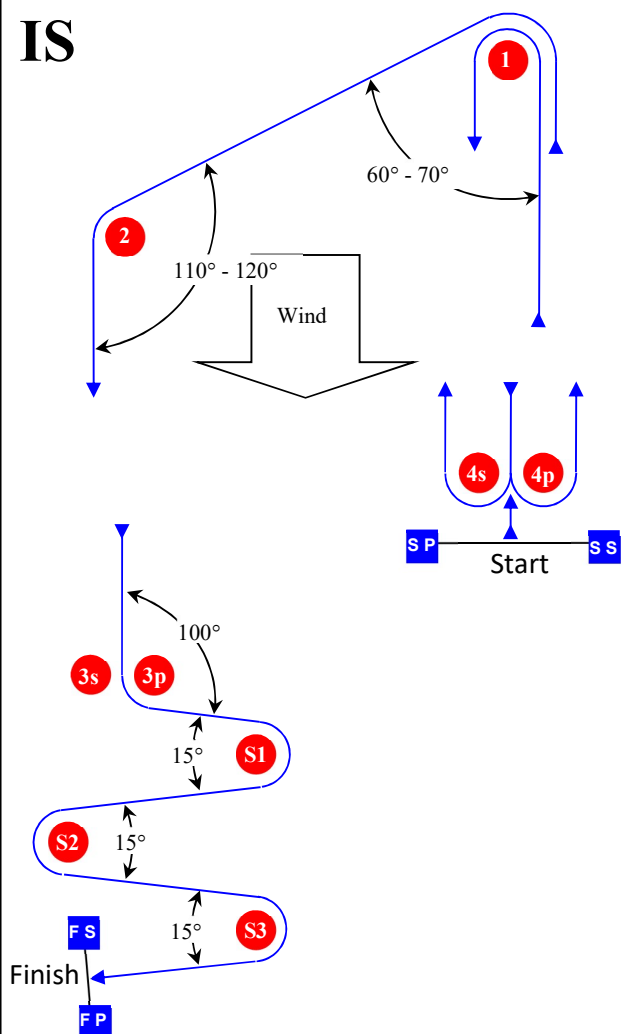
Course: Outer Trapezoid with beat to finish

Signal	Mark Rounding Order
OW2	Start – 1 – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW3	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW4	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish

Mark	Description
1 2	
3s 3p	
4s 4p	
5	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Trapezoid with slalom finish

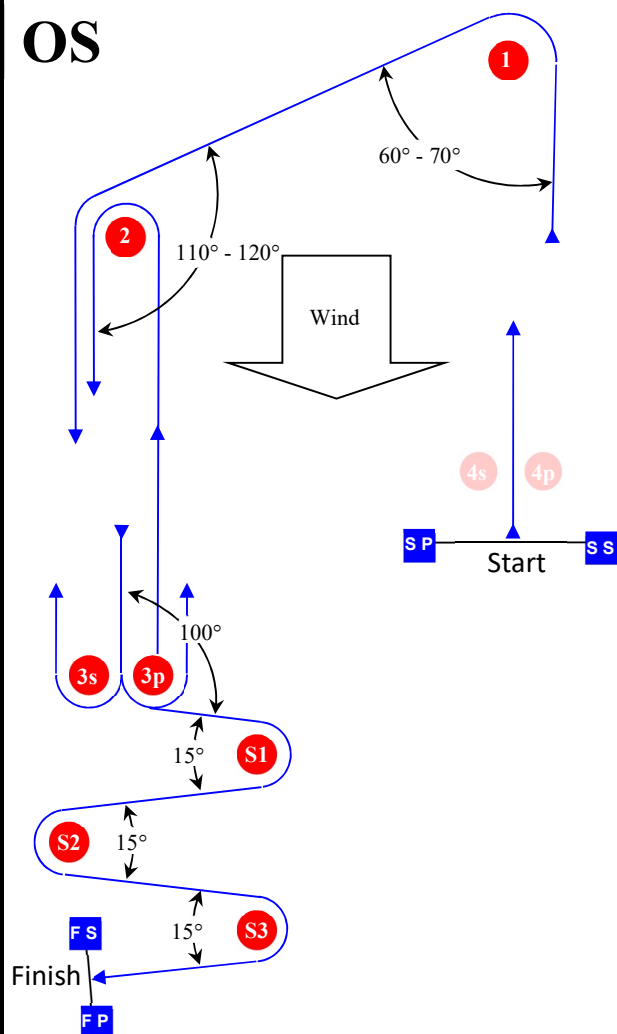
IS



Course: Inner trapezoid slalom finish

Signal	Mark Rounding Order
IS2	Start – 1 – 4s/4p – 1 – 2 – 3p – S1 – S2 – S3 – Finish
IS3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – S1 – S2 – S3 – Finish
IS4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – S1 – S2 – S3 – Finish

OS



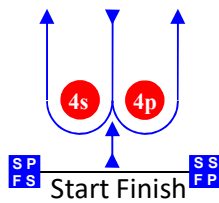
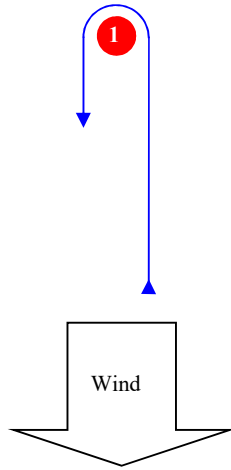
Course: Outer trapezoid slalom finish

Signal	Mark Rounding Order
OS2	Start – 1 – 2 – 3s/3p – 2 – 3p – S1 – S2 – S3 – Finish
OS3	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – S1 – S2 – S3 – Finish
OS4	Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – S1 – S2 – S3 – Finish

Mark	Description
1 2	
3s 3p	
4s 4p	
S1 S2 S3	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustrations – Windward Leeward

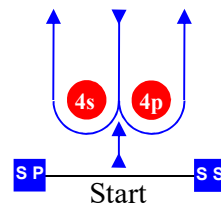
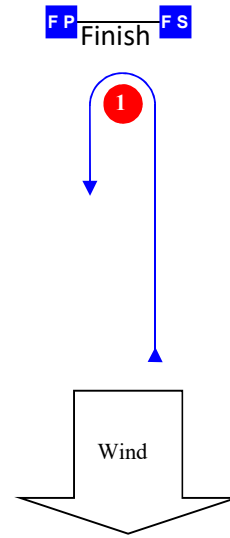
L



Course: Leeward finish

Signal	Mark Rounding Order
L2	Start – 1 – 4s/4p – 1 – Finish
L3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – Finish
L4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – Finish

W



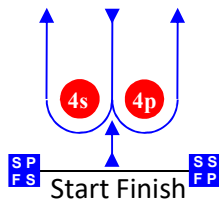
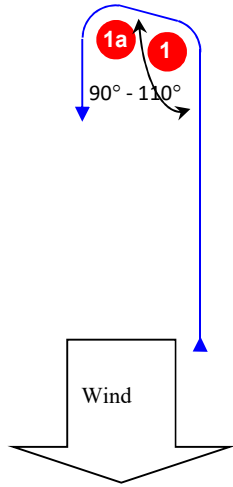
Course: Windward Finish

Signal	Mark Rounding Order
W2	Start – 1 – 4s/4p – Finish
W3	Start – 1 – 4s/4p – 1 – 4s/4p – Finish
W4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – Finish

Mark	Description	
1		
4s 4p		
SS Starting mark starboard end		
SP Starting mark port end		
	L	W
FS Finishing mark starboard end		
FP Finishing mark port end		

Course Illustrations – Windward Leeward with offset

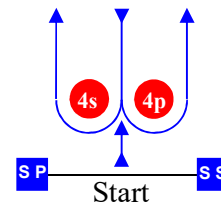
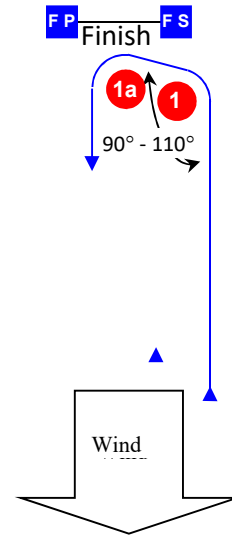
LA



Course: Leeward finish

Signal	Mark Rounding Order
LA2	Start – 1 – 1a – 4s/4p – 1 – 1a – Finish
LA3	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – Finish
LA4	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – Finish

WA



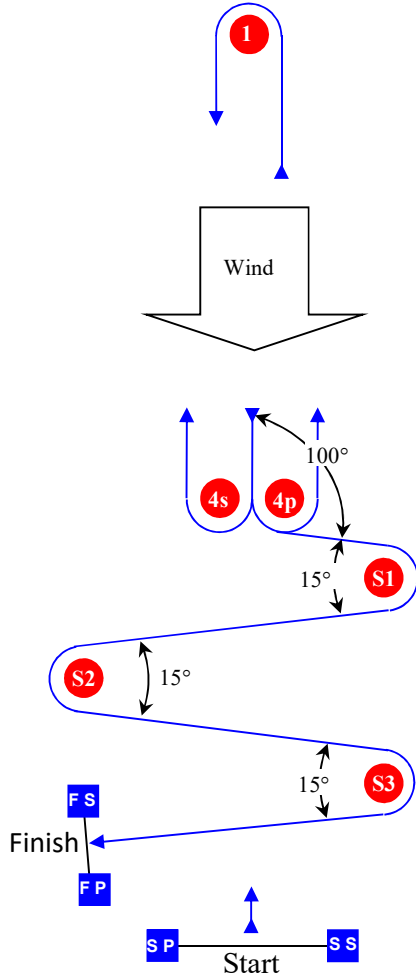
Course: Windward Finish

Signal	Mark Rounding Order
WA2	Start – 1 – 1a – 4s/4p – Finish
WA3	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – Finish
WA4	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – Finish

Mark	Description
1	
1a	
4s 4p	
SS	Starting mark starboard end
SP	Starting mark port end
	LA WA
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration - Windward leeward with slalom finish

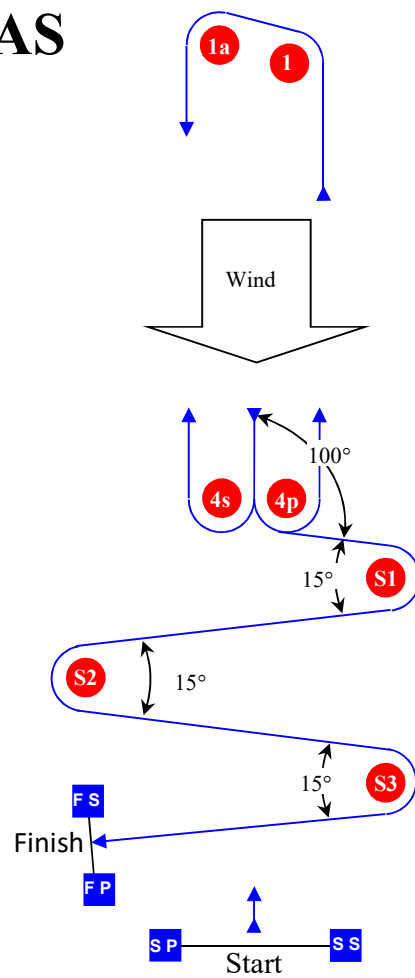
LS



Course: Windward Leeward slalom finish

Signal	Mark Rounding Order
LS2	Start – 1 – 4s/4p – 1 – 4p – S1 – S2 – S3 – Finish
LS3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4p – S1 – S2 – S3 – Finish
LS4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 4p – S1 – S2 – S3 – Finish

LAS



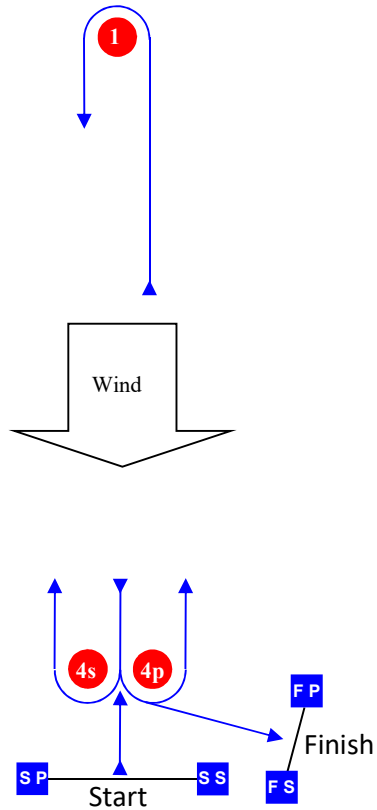
Course: Windward leeward with offset mark and slalom finish

Signal	Mark Rounding Order
LAS2	Start – 1 – 1a – 4s/4p – 1 – 4p – 1a – S1 – S2 – S3 – Finish
LAS3	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 4p – 1a – S1 – S2 – S3 – Finish
LAS4	Start – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 4s/4p – 1 – 1a – 4p – 1a – S1 – S2 – S3 – Finish

Mark	Description
1	
1a	
4s 4p	
S1 S2 S3	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Windward Leeward with reaching finish

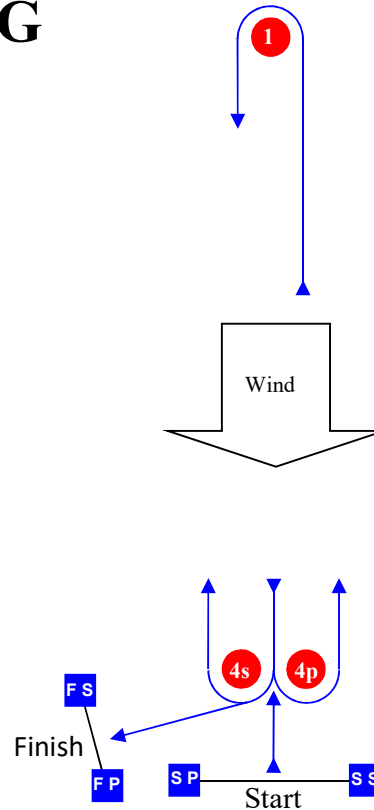
LR



Course: Leeward finish

Signal	Mark Rounding Order
LR2	Start – 1 – 4s/4p – 1 – 4p – Finish
LR3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4p – Finish
LR4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 4p – Finish

LG



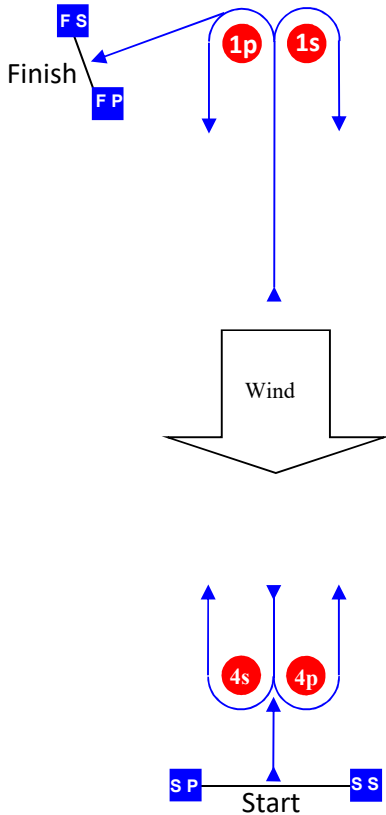
Course: Windward Finish

Signal	Mark Rounding Order
LG2	Start – 1 – 4s/4p – 1 – 4s – Finish
LG3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s – Finish
LG4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s – Finish

Mark	Description	
1		
4s 4p		
SS	Starting mark starboard end	
SP	Starting mark port end	
	LR	LG
FS	Finishing mark starboard end	
FP	Finishing mark port end	

Course Illustration – Windward Leeward with reaching finish (2)

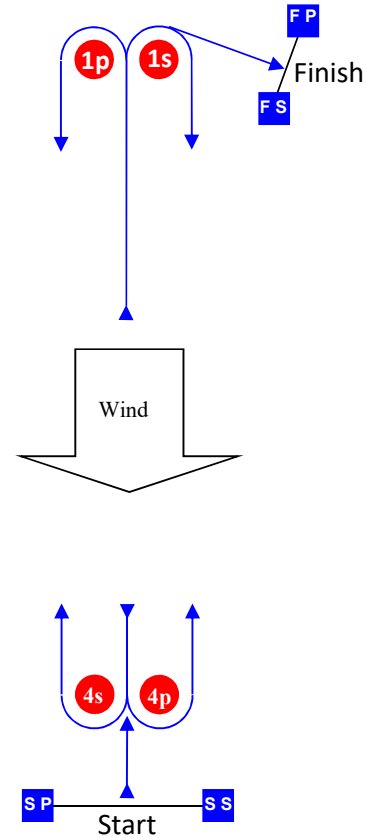
WR



Course: Leeward finish

Signal	Mark Rounding Order
WR2	Start – 1s/1p – 4s/4p – 1p – Finish
WR3	Start – 1s/1p – 4s/4p – 1s/1p – 4s/4p – 1p – Finish
WR4	Start – 1s/1p – 4s/4p – 1s/1p – 4s/4p – 1s/1p – 4s/4p – 1p – Finish

WG



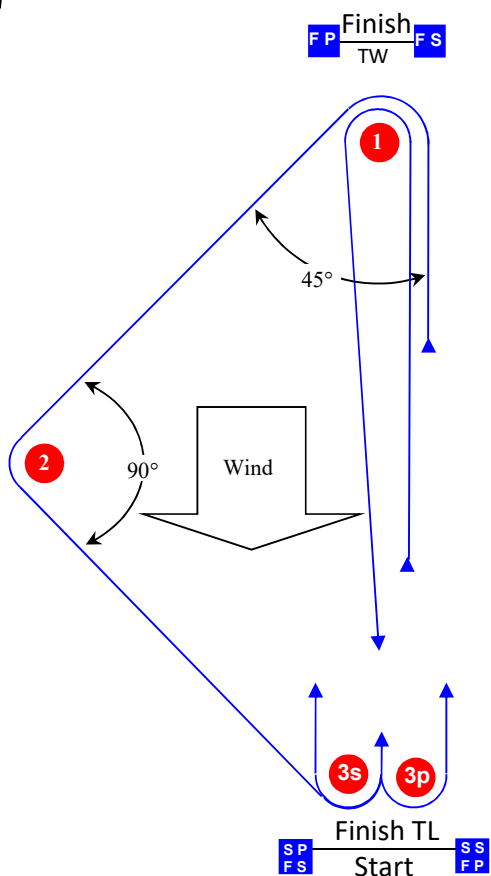
Course: Windward Finish

Signal	Mark Rounding Order
LG2	Start – 1s/1p – 4s/4p – 1s – Finish
LG3	Start – 1s/1p – 4s/4p – 1s/1p – 4s/4p – 1s – Finish
LG4	Start – 1s/1p – 4s/4p – 1s/1p – 4s/4p – 1s/1p – 4s/4p – 1s – Finish

Mark	Description
1s 1p	
4s 4p	
SS	Starting mark starboard end
SP	Starting mark port end
	WR WG
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Triangular course

TW / TL



Course: Triangular Upwind Finish

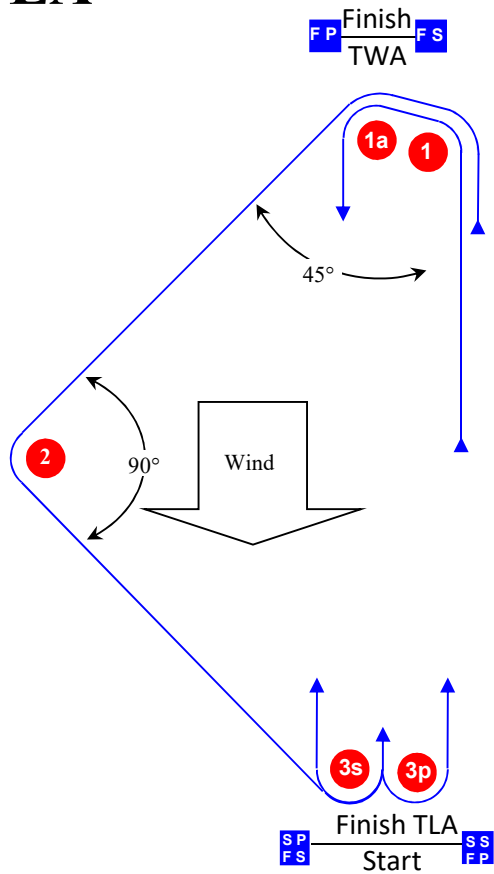
Course: Triangular Downwind Finish

Signal	Mark Rounding Order	Signal	Mark Rounding Order
TW2	Start – 1 – 2 – 3s(port) – Finish	TL2	Start – 1 – 2 – 3s(port) – 1 – Finish
TW3	Start – 1 – 2 – 3s(port) – 1 – 3s/3p – Finish	TL3	Start – 1 – 2 – 3s(port) – 1 – 3s/3p – 1 – Finish
TW4	Start – 1 – 2 – 3s(port) – 1 – 3s/3p – 1 – 2 – 3s(port) – Finish	TL4	Start – 1 – 2 – 3s(port) – 1 – 3s/3p – 1 – 2 – 3s(port) – 1 – Finish

Mark	Description
1	
2	
3s 3p	
SS	Starting mark starboard end
SP	Starting mark port end
	TW
	TL
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Triangular course with offset

TWA / TLA



Course: Triangular Upwind Finish

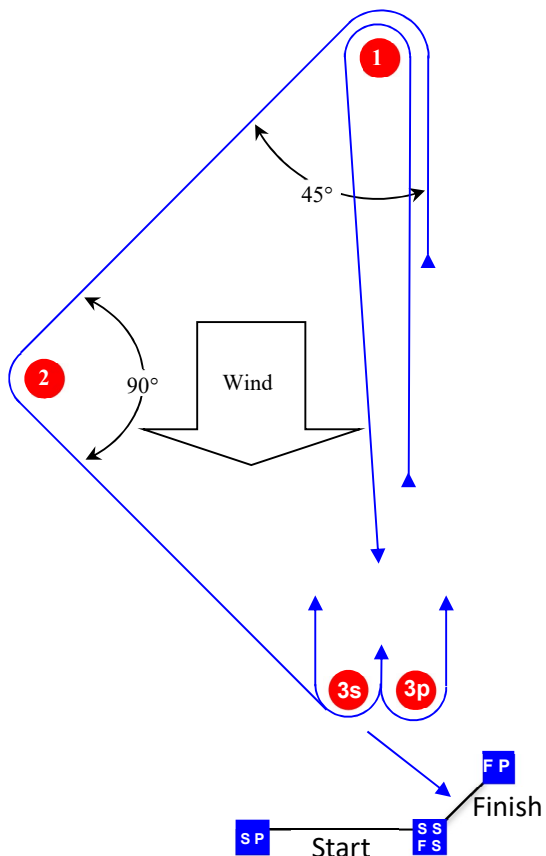
Course: Triangular Downwind Finish

Signal	Mark Rounding Order	Signal	Mark Rounding Order
TWA2	Start – 1 – 1a – 2 – 3s(port) – Finish	TLA2	Start – 1 – 1a – 2 – 3s(port) – 1 – 1a – Finish
TWA3	Start – 1 – 1a – 2 – 3s(port) – 1 – 1a – 3s/3p – Finish	TLA3	Start – 1 – 1a – 2 – 3s(port) – 1 – 1a – 3s/3p – 1 – 1a – Finish
TWA4	Start – 1 – 1a – 2 – 3s(port) – 1 – 1a – 3s/3p – 1 – 1a – 2 – 3s(port) – Finish	TLA4	Start – 1 – 1a – 2 – 3s(port) – 1 – 1a – 3s/3p – 1 – 1a – 2 – 3s(port) – 1 – 1a – Finish

Mark	Description	
1		
1a		
2		
3s 3p		
SS	Starting mark starboard end	
SP	Starting mark port end	
	TWA	TLA
FS	Finishing mark starboard end	
FP	Finishing mark port end	

Course Illustration – Triangular course reaching finish

TR



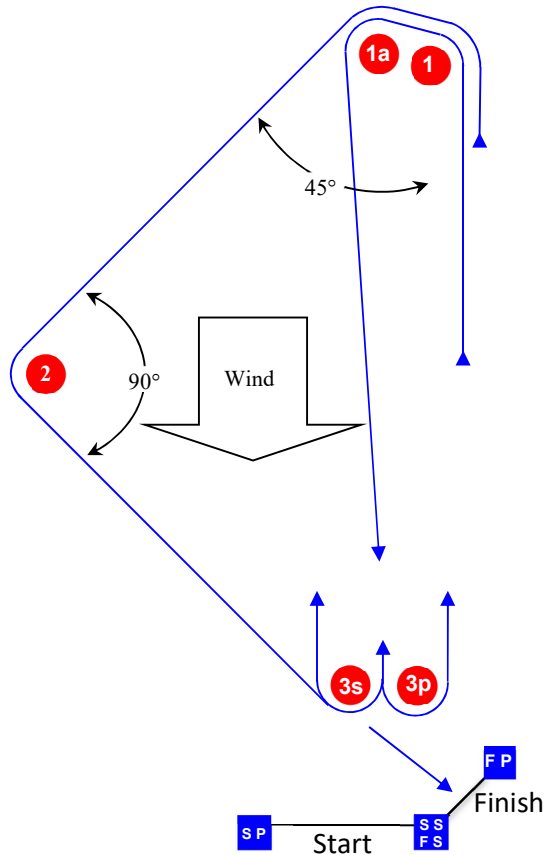
Course: Triangular Reaching Finish

Signal	Mark Rounding Order
TR1	Start – 1 – 2 – Finish
TR2	Start – 1 – 3s/3p – 1 – 2 – Finish
TR3	Start – 1 – 3s/3p – 1 – 3s/3p – 1 – 2 – Finish

Mark	Description
1	
2	
3s 3p	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Triangular course with offset reaching finish

TRA



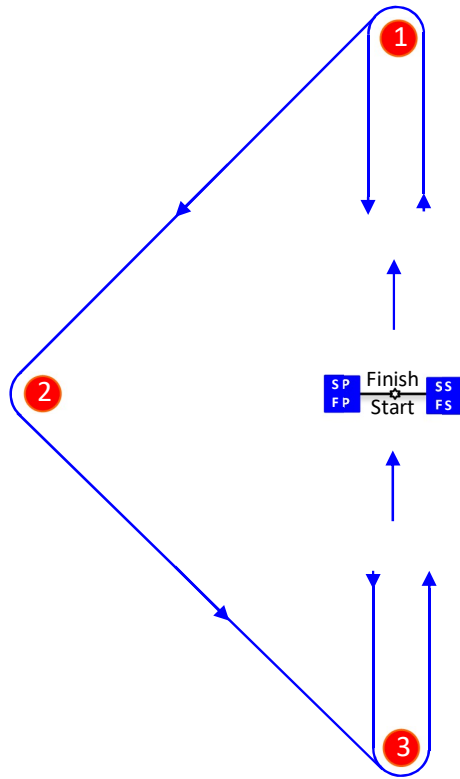
Course: Triangular with offset Reaching Finish

Signal	Mark Rounding Order
TRA1	Start – 1 – 1a – 2 – Finish
TRA2	Start – 1 – 1a – 3s/3p – 1 – 1a – 2 – Finish
TRA3	Start – 1 – 1a – 3s/3p – 1 – 1a – 3s/3p – 1 – 1a – 2 – Finish

Mark	Description
1	
1a	
2	
3s 3p	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Triangular course start finish middle of beat

T



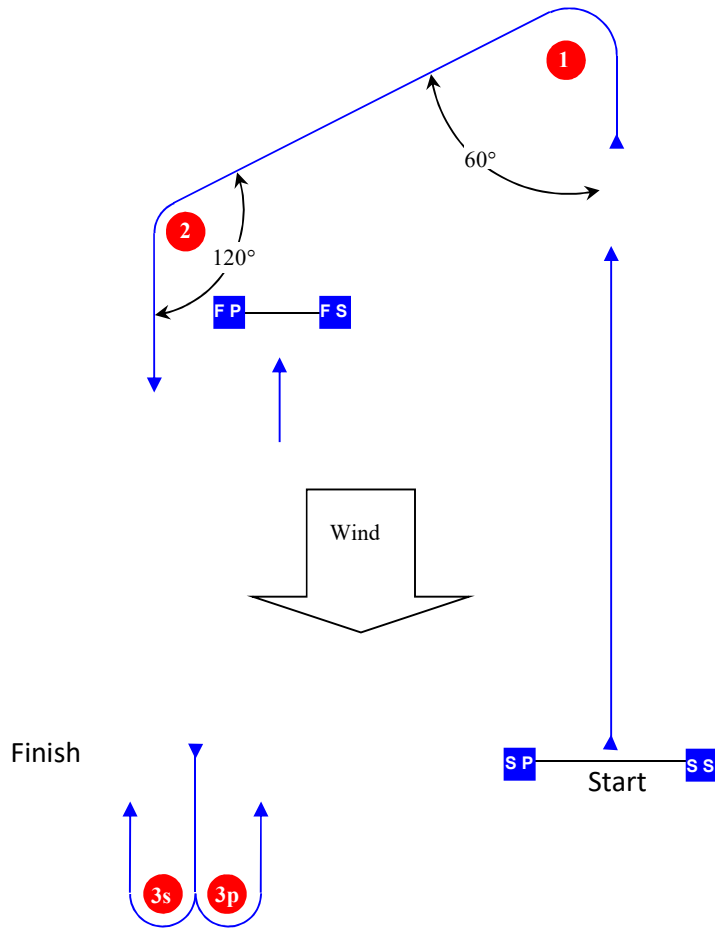
Course: Triangular with offset Reaching Finish

Signal	Mark Rounding Order
T1	Start – 1 – 2 – 3 – Finish
T2	Start – 1 – 2 – 3 – 1 – 3 – Finish
T3	Start – 1 – 2 – 3 – 1 – 3 – 1 – 2 – 3 – Finish

Mark	Description
1	
2	
3	
SS	Starting mark starboard end
SP	Starting mark port end
FS	Finishing mark starboard end
FP	Finishing mark port end

Course Illustration – Optimist course

IOD

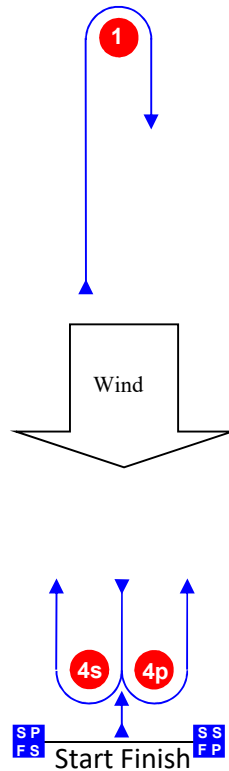


Signal	Mark Rounding Order
IOD	Start 1 – 2 – 3s/3p – Finish

Mark	Description
1	
2	
3s 3p	
SS Starting mark starboard end	
SP Starting mark port end	
FS Finishing mark starboard end	
FP Finishing mark port end	

Course Illustration – Match Racing

M



Course: Leeward finish

Signal	Mark Rounding Order
M2	Start – 1 – 4s/4p – 1 – Finish
M3	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – Finish
M4	Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – Finish

Mark	Description
1	
4s 4p	
SS Starting mark starboard end	
SP Starting mark port end	
FS Finishing mark starboard end	
FP Finishing mark port end	

Course Tables

The tables in the following pages are to help with laying the course.

Copying and laminating the appropriate course is advisable to enable its use in a wet environment.

Where there is a mark or gate immediately to windward of the starting line the reference point is set from this mark or gate.

For triangular course with the start finish in the middle of the beat and the optimist course the reference point is the middle of the starting line.

Trapezoid 60°, 120°, 120°, 60° interior angles Start Finish together. Reach = half beat length

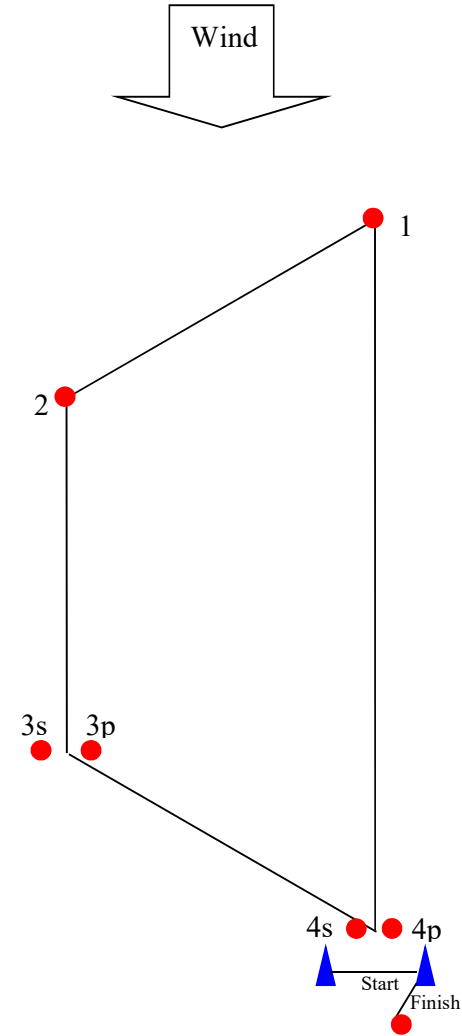
Course Axis	Angles in Degrees							
	1 - 4 3 - 2	4 - 2	2 - 4	1 - 2	2 - 1	4 - 3	3 - 4	Start Line
000	180	330	150	240	060	300	120	270
005	185	335	155	245	065	305	125	275
010	190	340	160	250	070	310	130	280
015	195	345	165	255	075	315	135	285
020	200	350	170	260	080	320	140	290
025	205	355	175	265	085	325	145	295
030	210	000	180	270	090	330	150	300
035	215	005	185	275	095	335	155	305
040	220	010	190	280	100	340	160	310
045	225	015	195	285	105	345	165	315
050	230	020	200	290	110	350	170	320
055	235	025	205	295	115	355	175	325
060	240	030	210	300	120	000	180	330
065	245	035	215	305	125	005	185	335
070	250	040	220	310	130	010	190	340
075	255	045	225	315	135	015	195	345
080	260	050	230	320	140	020	200	350
085	265	055	235	325	145	025	205	355
090	270	060	240	330	150	030	210	000
095	275	065	245	335	155	035	215	005
100	280	070	250	340	160	040	220	010
105	285	075	255	345	165	045	225	015
110	290	080	260	350	170	050	230	020
115	295	085	265	355	175	055	235	025
120	300	090	270	000	180	060	240	030
125	305	095	275	005	185	065	245	035
130	310	100	280	010	190	070	250	040
135	315	105	285	015	195	075	255	045
140	320	110	290	020	200	080	260	050
145	325	115	295	025	205	085	265	055
150	330	120	300	030	210	090	270	060
155	335	125	305	035	215	095	275	065
160	340	130	310	040	220	100	280	070
165	345	135	315	045	225	105	285	075
170	350	140	320	050	230	110	290	080
175	355	145	325	055	235	115	295	085

Course Axis	Angles in Degrees							
	1 - 4 2 - 3	4 - 2	2 - 4	1 - 2	2 - 1	4 - 3	3 - 4	Start Line
180	000	150	330	060	240	120	300	090
185	005	155	335	065	245	125	305	095
190	010	160	340	070	250	130	310	100
195	015	165	345	075	255	135	315	105
200	020	170	350	080	260	140	320	110
205	025	175	355	085	265	145	325	115
210	030	180	000	090	270	150	330	120
215	035	185	005	095	275	155	335	125
220	040	190	010	100	280	160	340	130
225	045	195	015	105	285	165	345	135
230	050	200	020	110	290	170	350	140
235	055	205	025	115	295	175	355	145
240	060	210	030	120	300	180	000	150
245	065	215	035	125	305	185	005	155
250	070	220	040	130	310	190	010	160
255	075	225	045	135	315	195	015	165
260	080	230	050	140	320	200	020	170
265	085	235	055	145	325	205	025	175
270	090	240	060	150	330	210	030	180
275	095	245	065	155	335	215	035	185
280	100	250	070	160	340	220	040	190
285	105	255	075	165	345	225	045	195
290	110	260	080	170	350	230	050	200
295	115	265	085	175	355	235	055	205
300	120	270	090	180	000	240	060	210
305	125	275	095	185	005	245	065	215
310	130	280	100	190	010	250	070	220
315	135	285	105	195	015	255	075	225
320	140	290	110	200	020	260	080	230
325	145	295	115	205	025	265	085	235
330	150	300	120	210	030	270	090	240
335	155	305	125	215	035	275	095	245
340	160	310	130	220	040	280	100	250
345	165	315	135	225	045	285	105	255
350	170	320	140	230	050	290	110	260
355	175	325	145	235	055	295	115	265

Trapezoid 60°, 120°, 120°, 60° interior angles Start Finish together. Reach = half beat length

Lengths in Nautical Miles				
4-1	4-2	4-3	1-2	2-3
1-4	2-4	3-4	2-1	3-2
0.2	0.17	0.1	0.1	0.1
0.3	0.26	0.15	0.15	0.15
0.4	0.35	0.2	0.2	0.2
0.5	0.43	0.25	0.25	0.25
0.6	0.52	0.3	0.3	0.3
0.7	0.61	0.35	0.35	0.35
0.8	0.69	0.4	0.4	0.4
0.9	0.78	0.45	0.45	0.45
1	0.87	0.5	0.5	0.5
1.1	0.95	0.55	0.55	0.55
1.2	1.04	0.6	0.6	0.6
1.3	1.13	0.65	0.65	0.65
1.4	1.21	0.7	0.7	0.7
1.5	1.3	0.75	0.75	0.75
1.6	1.39	0.8	0.8	0.8
1.7	1.47	0.85	0.85	0.85
1.8	1.56	0.9	0.9	0.9
1.9	1.65	0.95	0.95	0.95
2	1.73	1	1	1
2.1	1.82	1.05	1.05	1.05
2.2	1.91	1.1	1.1	1.1
2.3	1.99	1.15	1.15	1.15
2.4	2.08	1.2	1.2	1.2
2.5	2.17	1.25	1.25	1.25
2.6	2.25	1.3	1.3	1.3
2.7	2.34	1.35	1.35	1.35
2.8	2.42	1.4	1.4	1.4
2.9	2.51	1.45	1.45	1.45
3	2.6	1.5	1.5	1.5

Total Course Length in Nautical Miles					
I2	I3	I4	O2	O3	O4
0.95	1.35	1.75	0.75	0.95	1.15
1.4	2	2.6	1.1	1.4	1.7
1.85	2.65	3.45	1.45	1.85	2.25
2.3	3.3	4.3	1.8	2.3	2.8
2.75	3.95	5.15	2.15	2.75	3.35
3.2	4.6	6	2.5	3.2	3.9
3.65	5.25	6.85	2.85	3.65	4.45
4.1	5.9	7.7	3.2	4.1	5
4.55	6.55	8.55	3.55	4.55	5.55
5	7.2	9.4	3.9	5	6.1
5.45	7.85	10.25	4.25	5.45	6.65
5.9	8.5	11.1	4.6	5.9	7.2
6.35	9.15	11.95	4.95	6.35	7.75
6.8	9.8	12.8	5.3	6.8	8.3
7.25	10.45	13.65	5.65	7.25	8.85
7.7	11.1	14.5	6	7.7	9.4
8.15	11.75	15.35	6.35	8.15	9.95
8.6	12.4	16.2	6.7	8.6	10.5
9.05	13.05	17.05	7.05	9.05	11.05
9.5	13.7	17.9	7.4	9.5	11.6
9.95	14.35	18.75	7.75	9.95	12.15
10.4	15	19.6	8.1	10.4	12.7
10.85	15.65	20.45	8.45	10.85	13.25
11.3	16.3	21.3	8.8	11.3	13.8
11.75	16.95	22.15	9.15	11.75	14.35
12.2	17.6	23	9.5	12.2	14.9
12.65	18.25	23.85	9.85	12.65	15.45
13.1	18.9	24.7	10.2	13.1	16
13.55	19.55	25.55	10.55	13.55	16.55



- I2** Start – 1 – 4s/4p – 1 – 2 – 3p – Finish
- I3** Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
- I4** Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
- O2** Start – 1 – 2 – 3s/3p – 2 – 3p – Finish
- O3** Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish
- O4** Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish

Trapezoid 70°, 110°, 110°, 70° interior angles Start finish together. Reach = half beat length

Course Axis	Angle in degrees							
	4 - 1 3 - 2	1 - 4 2 - 3	4 - 2	2 - 4	1 - 2	2 - 1	4 - 3	3 - 4
000	180	330	150	250	070	290	110	270
005	185	335	155	255	075	295	115	275
010	190	340	160	260	080	300	120	280
015	195	345	165	265	085	305	125	285
020	200	350	170	270	090	310	130	290
025	205	355	175	275	095	315	135	295
030	210	000	180	280	100	320	140	300
035	215	005	185	285	105	325	145	305
040	220	010	190	290	110	330	150	310
045	225	015	195	295	115	335	155	315
050	230	020	200	300	120	340	160	320
055	235	025	205	305	125	345	165	325
060	240	030	210	310	130	350	170	330
065	245	035	215	315	135	355	175	335
070	250	040	220	320	140	000	180	340
075	255	045	225	325	145	005	185	345
080	260	050	230	330	150	010	190	350
085	265	055	235	335	155	015	195	355
090	270	060	240	340	160	020	200	000
095	275	065	245	345	165	025	205	005
100	280	070	250	350	170	030	210	010
105	285	075	255	355	175	035	215	015
110	290	080	260	000	180	040	220	020
115	295	085	265	005	185	045	225	025
120	300	090	270	010	190	050	230	030
125	305	095	275	015	195	055	235	035
130	310	100	280	020	200	060	240	040
135	315	105	285	025	205	065	245	045
140	320	110	290	030	210	070	250	050
145	325	115	295	035	215	075	255	055
150	330	120	300	040	220	080	260	060
155	335	125	305	045	225	085	265	065
160	340	130	310	050	230	090	270	070
165	345	135	315	055	235	095	275	075
170	350	140	320	060	240	100	280	080
175	355	145	325	065	245	105	285	085

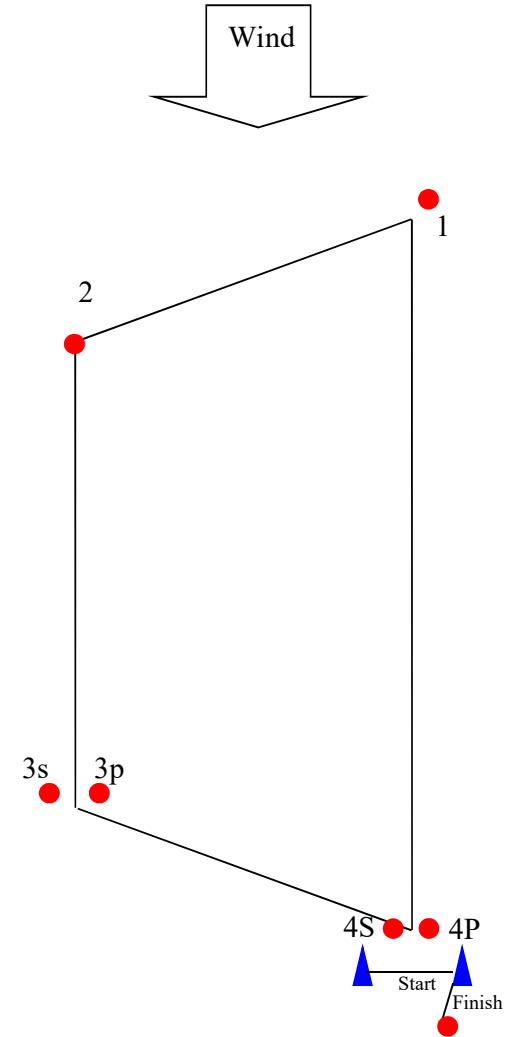
Course Axis	Angle in degrees							
	4 - 1 3 - 2	1 - 4 2 - 3	4 - 2	2 - 4	1 - 2	2 - 1	4 - 3	3 - 4
180	000	150	330	070	250	110	290	090
185	005	155	335	075	255	115	295	095
190	010	160	340	080	260	120	300	100
195	015	165	345	085	265	125	305	105
200	020	170	350	090	270	130	310	110
205	025	175	355	095	275	135	315	115
210	030	180	000	100	280	140	320	120
215	035	185	005	105	285	145	325	125
220	040	190	010	110	290	150	330	130
225	045	195	015	115	295	155	335	135
230	050	200	020	120	300	160	340	140
235	055	205	025	125	305	165	345	145
240	060	210	030	130	310	170	350	150
245	065	215	035	135	315	175	355	155
250	070	220	040	140	320	180	000	160
255	075	225	045	145	325	185	005	165
260	080	230	050	150	330	190	010	170
265	085	235	055	155	335	195	015	175
270	090	240	060	160	340	200	020	180
275	095	245	065	165	345	205	025	185
280	100	250	070	170	350	210	030	190
285	105	255	075	175	355	215	035	195
290	110	260	080	180	000	220	040	200
295	115	265	085	185	005	225	045	205
300	120	270	090	190	010	230	050	210
305	125	275	095	195	015	235	055	215
310	130	280	100	200	020	240	060	220
315	135	285	105	205	025	245	065	225
320	140	290	110	210	030	250	070	230
325	145	295	115	215	035	255	075	235
330	150	300	120	220	040	260	080	240
335	155	305	125	225	045	265	085	245
340	160	310	130	230	050	270	090	250
345	165	315	135	235	055	275	095	255
350	170	320	140	240	060	280	100	260
355	175	325	145	245	065	285	105	265

Trapezoid 70°, 110°, 110°, 70° interior angles Start finish together. Reach = half beat length

Lengths in Nautical Miles				
4-1	4-2	4-3	1-2	2-3
1-4	2-4	3-4	2-1	3-2
0.2	0.19	0.1	0.1	0.13
0.3	0.29	0.15	0.15	0.2
0.4	0.38	0.2	0.2	0.26
0.5	0.48	0.25	0.25	0.33
0.6	0.57	0.3	0.3	0.39
0.7	0.67	0.35	0.35	0.46
0.8	0.76	0.4	0.4	0.53
0.9	0.86	0.45	0.45	0.59
1	0.95	0.5	0.5	0.66
1.1	1.05	0.55	0.55	0.72
1.2	1.14	0.6	0.6	0.79
1.3	1.24	0.65	0.65	0.86
1.4	1.33	0.7	0.7	0.92
1.5	1.43	0.75	0.75	0.99
1.6	1.52	0.8	0.8	1.05
1.7	1.62	0.85	0.85	1.12
1.8	1.72	0.9	0.9	1.18
1.9	1.81	0.95	0.95	1.25
2	1.91	1	1	1.32
2.1	2	1.05	1.05	1.38
2.2	2.1	1.1	1.1	1.45
2.3	2.19	1.15	1.15	1.51
2.4	2.29	1.2	1.2	1.58
2.5	2.38	1.25	1.25	1.64
2.6	2.48	1.3	1.3	1.71
2.7	2.57	1.35	1.35	1.78
2.8	2.67	1.4	1.4	1.84
2.9	2.76	1.45	1.45	1.91
3	2.86	1.5	1.5	1.97

Total Course Length in Nautical Miles					
I2	I3	I4	O2	O3	O4
0.98	1.38	1.78	0.84	1.1	1.36
1.45	2.05	2.65	1.25	1.65	2.05
1.91	2.71	3.51	1.63	2.15	2.67
2.38	3.38	4.38	2.04	2.7	3.36
2.84	4.04	5.24	2.42	3.2	3.98
3.31	4.71	6.11	2.83	3.75	4.67
3.78	5.38	6.98	3.24	4.3	5.36
4.24	6.04	7.84	3.62	4.8	5.98
4.71	6.71	8.71	4.03	5.35	6.67
5.17	7.37	9.57	4.41	5.85	7.29
5.64	8.04	10.44	4.82	6.4	7.98
6.11	8.71	11.31	5.23	6.95	8.67
6.57	9.37	12.17	5.61	7.45	9.29
7.04	10.04	13.04	6.02	8	9.98
7.5	10.7	13.9	6.4	8.5	10.6
7.97	11.37	14.77	6.81	9.05	11.29
8.43	12.03	15.63	7.19	9.55	11.91
8.9	12.7	16.5	7.6	10.1	12.6
9.37	13.37	17.37	8.01	10.65	13.29
9.83	14.03	18.23	8.39	11.15	13.91
10.3	14.7	19.1	8.8	11.7	14.6
10.76	15.36	19.96	9.18	12.2	15.22
11.23	16.03	20.83	9.59	12.75	15.91
11.69	16.69	21.69	9.97	13.25	16.53
12.16	17.36	22.56	10.38	13.8	17.22
12.63	18.03	23.43	10.79	14.35	17.91
13.09	18.69	24.29	11.17	14.85	18.53
13.56	19.36	25.16	11.58	15.4	19.22
14.02	20.02	26.02	11.96	15.9	19.84

I2 Start – 1 – 4s/4p – 1 – 2 – 3p – Finish
I3 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
I4 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
O2 Start – 1 – 2 – 3s/3p – 2 – 3p – Finish
O3 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish
O4 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish



Trapezoid 60°, 120°, 120°, 60° interior angles equal beats. Reach = half beat length

Course Axis	Angles in degrees							
	1 - 4 2 - 3	4 - 2	2 - 4	4 - 3 1 - 2	3 - 4 2 - 1	F - 3	3 - F	Start Line
000	180	330	150	240	060	300	120	270
005	185	335	155	245	065	305	125	275
010	190	340	160	250	070	310	130	280
015	195	345	165	255	075	315	135	285
020	200	350	170	260	080	320	140	290
025	205	355	175	265	085	325	145	295
030	210	000	180	270	090	330	150	300
035	215	005	185	275	095	335	155	305
040	220	010	190	280	100	340	160	310
045	225	015	195	285	105	345	165	315
050	230	020	200	290	110	350	170	320
055	235	025	205	295	115	355	175	325
060	240	030	210	300	120	000	180	330
065	245	035	215	305	125	005	185	335
070	250	040	220	310	130	010	190	340
075	255	045	225	315	135	015	195	345
080	260	050	230	320	140	020	200	350
085	265	055	235	325	145	025	205	355
090	270	060	240	330	150	030	210	000
095	275	065	245	335	155	035	215	005
100	280	070	250	340	160	040	220	010
105	285	075	255	345	165	045	225	015
110	290	080	260	350	170	050	230	020
115	295	085	265	355	175	055	235	025
120	300	090	270	000	180	060	240	030
125	305	095	275	005	185	065	245	035
130	310	100	280	010	190	070	250	040
135	315	105	285	015	195	075	255	045
140	320	110	290	020	200	080	260	050
145	325	115	295	025	205	085	265	055
150	330	120	300	030	210	090	270	060
155	335	125	305	035	215	095	275	065
160	340	130	310	040	220	100	280	070
165	345	135	315	045	225	105	285	075
170	350	140	320	050	230	110	290	080
175	355	145	325	055	235	115	295	085

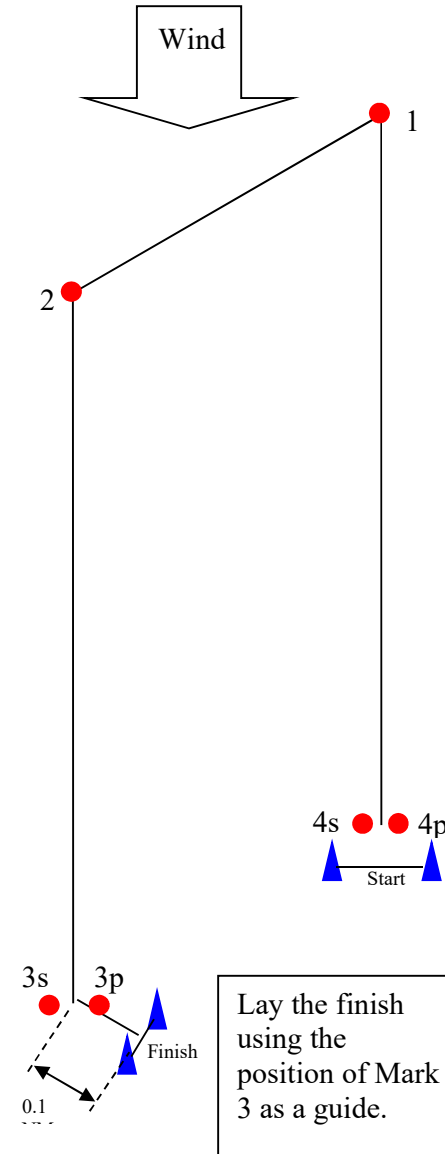
Course Axis	Angles in degrees							
	1 - 4 2 - 3	4 - 2	2 - 4	4 - 3 1 - 2	3 - 4 2 - 1	F - 3	3 - F	Start Line
180	000	150	330	060	240	120	300	090
185	005	155	335	065	245	125	305	095
190	010	160	340	070	250	130	310	100
195	015	165	345	075	255	135	315	105
200	020	170	350	080	260	140	320	110
205	025	175	355	085	265	145	325	115
210	030	180	000	090	270	150	330	120
215	035	185	005	095	275	155	335	125
220	040	190	010	100	280	160	340	130
225	045	195	015	105	285	165	345	135
230	050	200	020	110	290	170	350	140
235	055	205	025	115	295	175	355	145
240	060	210	030	120	300	180	000	150
245	065	215	035	125	305	185	005	155
250	070	220	040	130	310	190	010	160
255	075	225	045	135	315	195	015	165
260	080	230	050	140	320	200	020	170
265	085	235	055	145	325	205	025	175
270	090	240	060	150	330	210	030	180
275	095	245	065	155	335	215	035	185
280	100	250	070	160	340	220	040	190
285	105	255	075	165	345	225	045	195
290	110	260	080	170	350	230	050	200
295	115	265	085	175	355	235	055	205
300	120	270	090	180	000	240	060	210
305	125	275	095	185	005	245	065	215
310	130	280	100	190	010	250	070	220
315	135	285	105	195	015	255	075	225
320	140	290	110	200	020	260	080	230
325	145	295	115	205	025	265	085	235
330	150	300	120	210	030	270	090	240
335	155	305	125	215	035	275	095	245
340	160	310	130	220	040	280	100	250
345	165	315	135	225	045	285	105	255
350	170	320	140	230	050	290	110	260
355	175	325	145	235	055	295	115	265

Trapezoid 60°, 120°, 120°, 60° interior angles equal beats. Reach = half beat length

Lengths in Nautical Miles		
4 - 1	4 - 2	4 - 3
1 - 4	2 - 4	3 - 4
2 - 3		1 - 2
3 - 2		2 - 1
0.3	0.26	0.15
0.4	0.35	0.2
0.5	0.43	0.25
0.6	0.52	0.3
0.7	0.61	0.35
0.8	0.69	0.4
0.9	0.78	0.45
1	0.87	0.5
1.1	0.95	0.55
1.2	1.04	0.6
1.3	1.13	0.65
1.4	1.21	0.7
1.5	1.3	0.75
1.6	1.39	0.8
1.7	1.47	0.85
1.8	1.56	0.9
1.9	1.65	0.95
2	1.73	1
2.1	1.82	1.05
2.2	1.91	1.1
2.3	1.99	1.15
2.4	2.08	1.2
2.5	2.17	1.25
2.6	2.25	1.3
2.7	2.34	1.35
2.8	2.42	1.4
2.9	2.51	1.45
3	2.6	1.5

Total Course Length in Nautical Miles					
I2	I3	I4	O2	O3	O4
1.50	2.10	2.70	1.50	2.10	2.70
1.95	2.75	3.55	1.95	2.75	3.55
2.40	3.40	4.40	2.40	3.40	4.40
2.85	4.05	5.25	2.85	4.05	5.25
3.30	4.70	6.10	3.30	4.70	6.10
3.75	5.35	6.95	3.75	5.35	6.95
4.20	6.00	7.80	4.20	6.00	7.80
4.65	6.65	8.65	4.65	6.65	8.65
5.10	7.30	9.50	5.10	7.30	9.50
5.55	7.95	10.35	5.55	7.95	10.35
6.00	8.60	11.20	6.00	8.60	11.20
6.45	9.25	12.05	6.45	9.25	12.05
6.90	9.90	12.90	6.90	9.90	12.90
7.35	10.55	13.75	7.35	10.55	13.75
7.80	11.20	14.60	7.80	11.20	14.60
8.25	11.85	15.45	8.25	11.85	15.45
8.70	12.50	16.30	8.70	12.50	16.30
9.15	13.15	17.15	9.15	13.15	17.15
9.60	13.80	18.00	9.60	13.80	18.00
10.05	14.45	18.85	10.05	14.45	18.85
10.50	15.10	19.70	10.50	15.10	19.70
10.95	15.75	20.55	10.95	15.75	20.55
11.40	16.40	21.40	11.40	16.40	21.40
11.85	17.05	22.25	11.85	17.05	22.25
12.30	17.70	23.10	12.30	17.70	23.10
12.75	18.35	23.95	12.75	18.35	23.95
13.20	19.00	24.80	13.20	19.00	24.80
13.65	19.65	25.65	13.65	19.65	25.65

- I2 Start - 1 - 4s/4p - 1 - 2 - 3p - Finish
- I3 Start - 1 - 4s/4p - 1 - 4s/4p - 1 - 2 - 3p - Finish
- I4 Start - 1 - 4s/4p - 1 - 4s/4p - 1 - 4s/4p - 1 - 2 - 3p - Finish
- O2 Start - 1 - 2 - 3s/3p - 2 - 3p - Finish
- O3 Start - 1 - 2 - 3s/3p - 2 - 3s/3p - 2 - 3p - Finish
- O4 Start - 1 - 2 - 3s/3p - 2 - 3s/3p - 2 - 3s/3p - 2 - 3p - Finish



Trapezoid 70°, 110°, 110°, 70° interior angles equal beats. Reach = half beat length

Course Axis	Angles in degrees							
	4-1 3-2	1-4 2-3	4-2	2-4	4-3 1-2	3-4 2-1	F-3	3-F
000	180	330	150	250	070	290	110	270
005	185	335	155	255	075	295	115	275
010	190	340	160	260	080	300	120	280
015	195	345	165	265	085	305	125	285
020	200	350	170	270	090	310	130	290
025	205	355	175	275	095	315	135	295
030	210	000	180	280	100	320	140	300
035	215	005	185	285	105	325	145	305
040	220	010	190	290	110	330	150	310
045	225	015	195	295	115	335	155	315
050	230	020	200	300	120	340	160	320
055	235	025	205	305	125	345	165	325
060	240	030	210	310	130	350	170	330
065	245	035	215	315	135	355	175	335
070	250	040	220	320	140	000	180	340
075	255	045	225	325	145	005	185	345
080	260	050	230	330	150	010	190	350
085	265	055	235	335	155	015	195	355
090	270	060	240	340	160	020	200	000
095	275	065	245	345	165	025	205	005
100	280	070	250	350	170	030	210	010
105	285	075	255	355	175	035	215	015
110	290	080	260	000	180	040	220	020
115	295	085	265	005	185	045	225	025
120	300	090	270	010	190	050	230	030
125	305	095	275	015	195	055	235	035
130	310	100	280	020	200	060	240	040
135	315	105	285	025	205	065	245	045
140	320	110	290	030	210	070	250	050
145	325	115	295	035	215	075	255	055
150	330	120	300	040	220	080	260	060
155	335	125	305	045	225	085	265	065
160	340	130	310	050	230	090	270	070
165	345	135	315	055	235	095	275	075
170	350	140	320	060	240	100	280	080
175	355	145	325	065	245	105	285	085

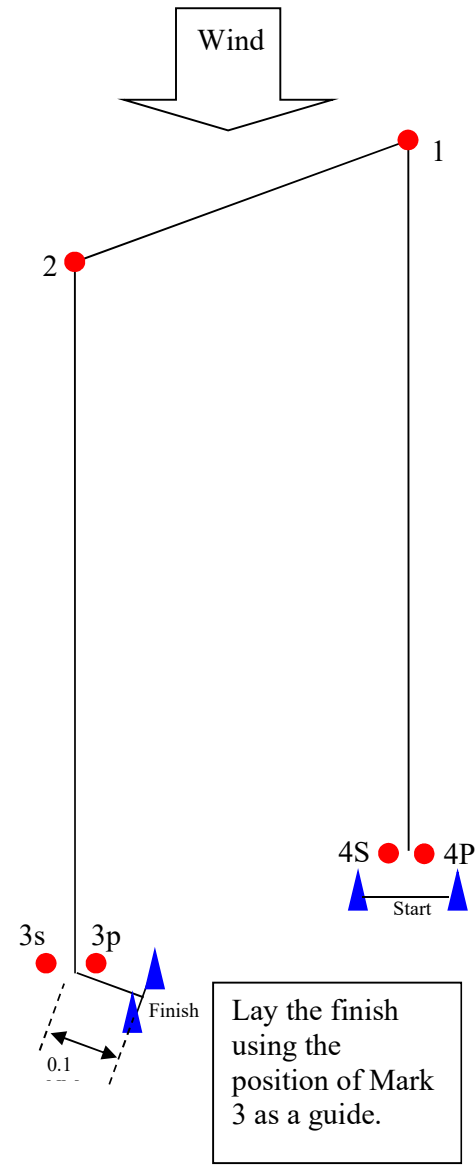
Course Axis	Angles in degrees							
	4-1 3-2	1-4 2-3	4-2	2-4	4-3 1-2	3-4 2-1	F-3	3-F
180	000	150	330	070	250	110	290	090
185	005	155	335	075	255	115	295	095
190	010	160	340	080	260	120	300	100
195	015	165	345	085	265	125	305	105
200	020	170	350	090	270	130	310	110
205	025	175	355	095	275	135	315	115
210	030	180	000	100	280	140	320	120
215	035	185	005	105	285	145	325	125
220	040	190	010	110	290	150	330	130
225	045	195	015	115	295	155	335	135
230	050	200	020	120	300	160	340	140
235	055	205	025	125	305	165	345	145
240	060	210	030	130	310	530	350	150
245	065	215	035	135	315	535	355	155
250	070	220	040	140	320	180	000	160
255	075	225	045	145	325	185	005	165
260	080	230	050	150	330	190	010	170
265	085	235	055	155	335	195	015	175
270	090	240	060	160	340	200	020	180
275	095	245	065	165	345	205	025	185
280	100	250	070	170	350	210	030	190
285	105	255	075	175	355	215	035	195
290	110	260	080	180	360	220	040	200
295	115	265	085	185	365	225	045	205
300	120	270	090	190	010	230	050	210
305	125	275	095	195	015	235	055	215
310	130	280	100	200	020	240	060	220
315	135	285	105	205	025	245	065	225
320	140	290	110	210	030	250	070	230
325	145	295	115	215	035	255	075	235
330	150	300	120	220	040	260	080	240
335	155	305	125	225	045	265	085	245
340	160	310	130	230	050	270	090	250
345	165	315	135	235	055	275	095	255
350	170	320	140	240	060	280	100	260
355	175	325	145	245	065	285	105	265

Trapezoid 70°, 110°, 110°, 70° interior angles equal beats. Reach = half beat length

Lengths in Nautical Miles		
4-1	4-2	4-3
1-4	2-4	3-4
2-3		1-2
3-2		2-1
0.3	0.29	0.15
0.4	0.38	0.2
0.5	0.48	0.25
0.6	0.57	0.3
0.7	0.67	0.35
0.8	0.76	0.4
0.9	0.86	0.45
1	0.95	0.5
1.1	1.05	0.55
1.2	1.14	0.6
1.3	1.24	0.65
1.4	1.33	0.7
1.5	1.43	0.75
1.6	1.52	0.8
1.7	1.62	0.85
1.8	1.72	0.9
1.9	1.81	0.95
2	1.91	1
2.1	2	1.05
2.2	2.1	1.1
2.3	2.19	1.15
2.4	2.29	1.2
2.5	2.38	1.25
2.6	2.48	1.3
2.7	2.57	1.35
2.8	2.67	1.4
2.9	2.76	1.45
3	2.86	1.5

Total Course Length in Nautical Miles					
I2	I3	I4	O2	O3	O4
1.50	2.10	2.70	1.50	2.10	2.70
1.95	2.75	3.55	1.95	2.75	3.55
2.40	3.40	4.40	2.40	3.40	4.40
2.85	4.05	5.25	2.85	4.05	5.25
3.30	4.70	6.10	3.30	4.70	6.10
3.75	5.35	6.95	3.75	5.35	6.95
4.20	6.00	7.80	4.20	6.00	7.80
4.65	6.65	8.65	4.65	6.65	8.65
5.10	7.30	9.50	5.10	7.30	9.50
5.55	7.95	10.35	5.55	7.95	10.35
6.00	8.60	11.20	6.00	8.60	11.20
6.45	9.25	12.05	6.45	9.25	12.05
6.90	9.90	12.90	6.90	9.90	12.90
7.35	10.55	13.75	7.35	10.55	13.75
7.80	11.20	14.60	7.80	11.20	14.60
8.25	11.85	15.45	8.25	11.85	15.45
8.70	12.50	16.30	8.70	12.50	16.30
9.15	13.15	17.15	9.15	13.15	17.15
9.60	13.80	18.00	9.60	13.80	18.00
10.05	14.45	18.85	10.05	14.45	18.85
10.50	15.10	19.70	10.50	15.10	19.70
10.95	15.75	20.55	10.95	15.75	20.55
11.40	16.40	21.40	11.40	16.40	21.40
11.85	17.05	22.25	11.85	17.05	22.25
12.30	17.70	23.10	12.30	17.70	23.10
12.75	18.35	23.95	12.75	18.35	23.95
13.20	19.00	24.80	13.20	19.00	24.80
13.65	19.65	25.65	13.65	19.65	25.65

- I2** Start – 1 – 4s/4p – 1 – 2 – 3p – Finish
- I3** Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
- I4** Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – Finish
- O2** Start – 1 – 2 – 3s/3p – 2 – 3p – Finish
- O3** Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish
- O4** Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – Finish



Trapezoid Course 60°, 120° interior angles equal beats. Reach = 2/3 beat length

Course Axis	Angles in Degrees									
	4 - 1	1 - 4	4 - 2	2 - 4	4 - 3	3 - 4	Signal	Pin -	3 -	Finish
3 - 2	2 - 3			1 - 2	2 - 1	- Pin	Signal	Finish	- 3	
000	180	319	139	240	060	270	090	120	300	
005	185	324	144	245	065	275	095	125	305	
010	190	329	149	250	070	280	100	130	310	
015	195	334	154	255	075	285	105	135	315	
020	200	339	159	260	080	290	110	140	320	
025	205	344	164	265	085	295	115	145	325	
030	210	349	169	270	090	300	120	150	330	
035	215	354	174	275	095	305	125	155	335	
040	220	359	179	280	100	310	130	160	340	
045	225	004	184	285	105	315	135	165	345	
050	230	009	189	290	110	320	140	170	350	
055	235	014	194	295	115	325	145	175	355	
060	240	019	199	300	120	330	150	180	000	
065	245	024	204	305	125	335	155	185	005	
070	250	029	209	310	130	340	160	190	010	
075	255	034	214	315	135	345	165	195	015	
080	260	039	219	320	140	350	170	200	020	
085	265	044	224	325	145	355	175	205	025	
090	270	049	229	330	150	000	180	210	030	
095	275	054	234	335	155	005	185	215	035	
100	280	059	239	340	160	010	190	220	040	
105	285	064	244	345	165	015	195	225	045	
110	290	069	249	350	170	020	200	230	050	
115	295	074	254	355	175	025	205	235	055	
120	300	079	259	000	180	030	210	240	060	
125	305	084	264	005	185	035	215	245	065	
130	310	089	269	010	190	040	220	250	070	
135	315	094	274	015	195	045	225	255	075	
140	320	099	279	020	200	050	230	260	080	
145	325	104	284	025	205	055	235	265	085	
150	330	109	289	030	210	060	240	270	090	
155	335	114	294	035	215	065	245	275	095	
160	340	119	299	040	220	070	250	280	100	
165	345	124	304	045	225	075	255	285	105	
170	350	129	309	050	230	080	260	290	110	
175	355	134	314	055	235	085	265	295	115	

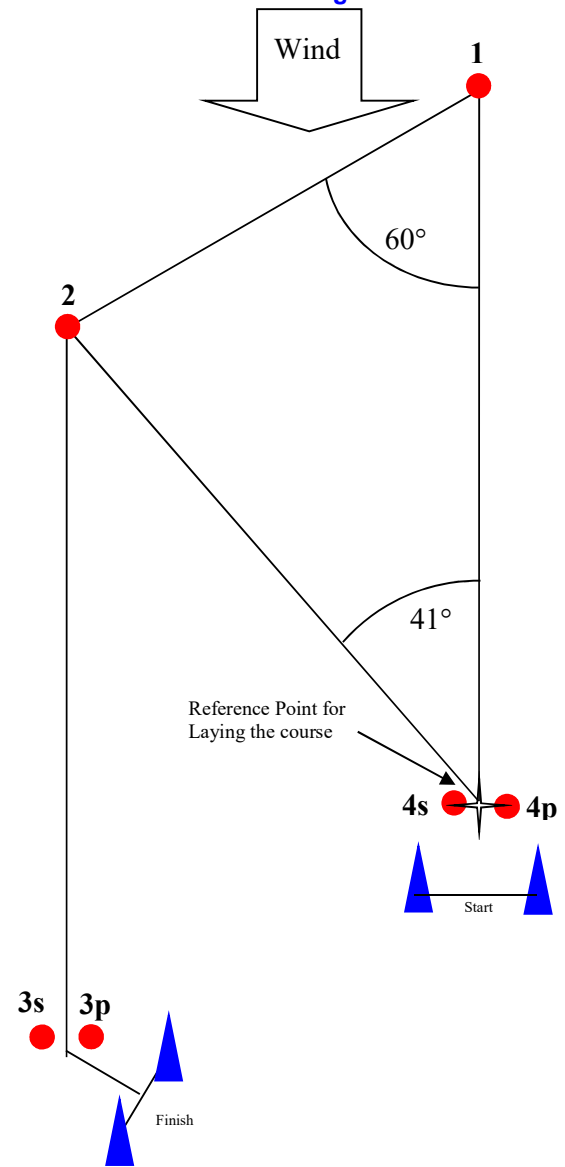
Course Axis	Angles in Degrees									
	4 - 1	1 - 4	4 - 2	2 - 4	4 - 3	3 - 4	Signal	Pin -	3 -	Finish
3 - 2	2 - 3			1 - 2	2 - 1	- Pin	Signal	Finish	- 3	
180	000	139	319	060	240	090	270	300	120	
185	005	144	324	065	245	095	275	305	125	
190	010	149	329	070	250	100	280	310	130	
195	015	154	334	075	255	105	285	315	135	
200	020	159	339	080	260	110	290	320	140	
205	025	164	344	085	265	115	295	325	145	
210	030	169	349	090	270	120	300	330	150	
215	035	174	354	095	275	125	305	335	155	
220	040	179	359	100	280	130	310	340	160	
225	045	184	004	105	285	135	315	345	165	
230	050	189	009	110	290	140	320	350	170	
235	055	194	014	115	295	145	325	355	175	
240	060	199	019	120	300	150	330	000	180	
245	065	204	024	125	305	155	335	005	185	
250	070	209	029	130	310	160	340	010	190	
255	075	214	034	135	315	165	345	015	195	
260	080	219	039	140	320	170	350	020	200	
265	085	224	044	145	325	175	355	025	205	
270	090	229	049	150	330	180	000	030	210	
275	095	234	054	155	335	185	005	035	215	
280	100	239	059	160	340	190	010	040	220	
285	105	244	064	165	345	195	015	045	225	
290	110	249	069	170	350	200	020	050	230	
295	115	254	074	175	355	205	025	055	235	
300	120	259	079	180	000	210	030	060	240	
305	125	264	084	185	005	215	035	065	245	
310	130	269	089	190	010	220	040	070	250	
315	135	274	094	195	015	225	045	075	255	
320	140	279	099	200	020	230	050	080	260	
325	145	284	104	205	025	235	055	085	265	
330	150	289	109	210	030	240	060	090	270	
335	155	294	114	215	035	245	065	095	275	
340	160	299	119	220	040	250	070	100	280	
345	165	304	124	225	045	255	075	105	285	
350	170	309	129	230	050	260	080	110	290	
355	175	314	134	235	055	265	085	115	295	

Trapezoid Course 60°, 120° interior angles equal beats. Reach = 2/3 beat length

Leg lengths		
4 - 1 & 1 - 4	4 - 2	1 - 2 & 2 - 1
2 - 3 & 3 - 2	& 2 - 4	4 - 3 & 3 - 4
0.20	0.18	0.13
0.25	0.22	0.17
0.30	0.26	0.20
0.35	0.31	0.23
0.40	0.35	0.27
0.45	0.40	0.30
0.50	0.44	0.33
0.55	0.48	0.37
0.60	0.53	0.40
0.65	0.57	0.43
0.70	0.62	0.47
0.75	0.66	0.50
0.80	0.70	0.53
0.85	0.75	0.57
0.90	0.79	0.60
0.95	0.84	0.63
1.00	0.88	0.67
1.10	0.97	0.73
1.20	1.06	0.80
1.30	1.14	0.87
1.40	1.23	0.93
1.50	1.32	1.00
1.60	1.41	1.07
1.70	1.50	1.13
1.80	1.58	1.20
1.90	1.67	1.27
2.00	1.76	1.33

Course Distances		
I2	I3	I4
O2	O3	O4
1.13	1.53	1.93
1.37	1.87	2.37
1.06	2.20	2.80
1.83	2.53	3.23
2.07	2.87	3.67
2.30	3.20	4.10
2.53	3.53	4.53
2.77	3.87	4.97
3.00	4.20	5.40
3.23	4.53	5.83
3.47	4.87	6.27
3.70	5.20	6.70
3.93	5.53	7.13
4.17	5.87	7.57
4.40	6.20	8.00
4.63	6.53	8.43
4.87	6.87	8.87
5.33	7.53	9.73
5.80	8.2	10.60
6.27	8.87	11.47
6.73	9.53	12.33
7.20	10.20	13.20
7.67	10.87	14.07
8.13	11.53	14.93
8.60	12.20	15.80
9.07	12.87	16.67
9.53	13.53	17.53

- I2 Start - 1 - 4s/4p - 1 - 2 - 3p - Finish
- I3 Start - 1 - 4s/4p - 1 - 4s/4p - 1 - 2 - 3p - Finish
- I4 Start - 1 - 4s/4p - 1 - 4s/4p - 1 - 4s/4p - 1 - 2 - 3p - Finish
- O2 Start - 1 - 2 - 3s/3p - 2 - 3p - Finish
- O3 Start - 1 - 2 - 3s/3p - 2 - 3s/3p - 2 - 3p - Finish
- O4 Start - 1 - 2 - 3s/3p - 2 - 3s/3p - 2 - 3s/3p - 2 - 3p - Finish



Trapezoid Course 70°, 110° interior angles. Reach = 2/3 beat length

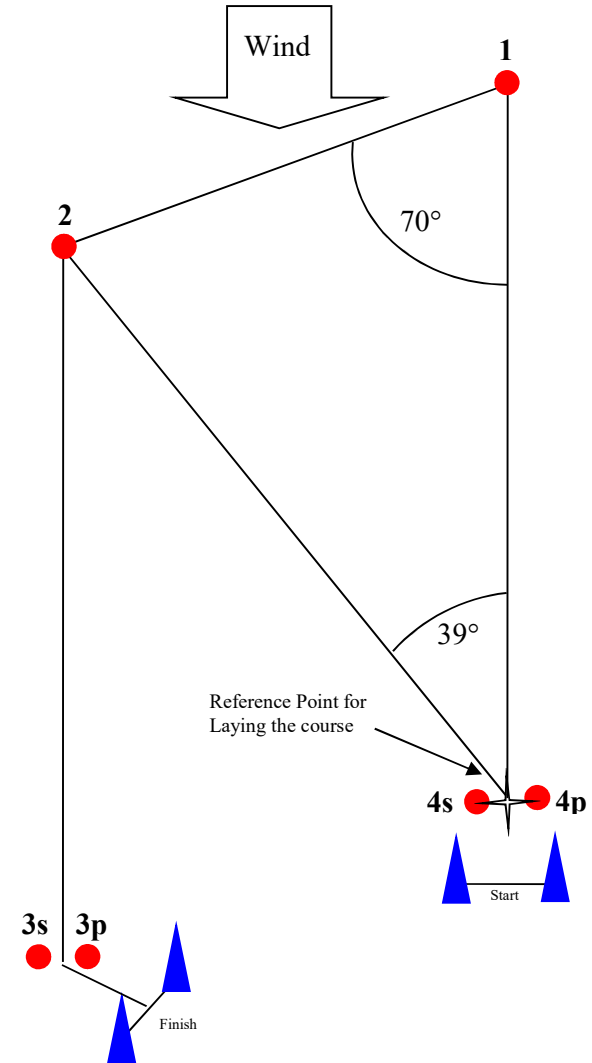
Course Axis	Angles in Degrees								
4 - 1	1 - 4	4 - 2	2 - 4	4 - 3	3 - 4	Signal	Pin -	3 -	Finish
3 - 2	2 - 3			1 - 2	2 - 1	- Pin	Signal	Finish	- 3
000	180	321	141	250	070	270	090	110	290
005	185	326	146	255	075	275	095	115	295
010	190	331	151	260	080	280	100	120	300
015	195	336	156	265	085	285	105	125	305
020	200	341	161	270	090	290	110	130	310
025	205	346	166	275	095	295	115	135	315
030	210	351	171	280	100	300	120	140	320
035	215	356	176	285	105	305	125	145	325
040	220	001	181	290	110	310	130	150	330
045	225	006	186	295	115	315	135	155	335
050	230	011	191	300	120	320	140	160	340
055	235	016	196	305	125	325	145	165	345
060	240	021	201	310	130	330	150	170	350
065	245	026	206	315	135	335	155	175	355
070	250	031	211	320	140	340	160	180	000
075	255	036	216	325	145	345	165	185	005
080	260	041	221	330	150	350	170	190	010
085	265	046	226	335	155	355	175	195	015
090	270	051	231	340	160	000	180	200	020
095	275	056	236	345	165	005	185	205	025
100	280	061	241	350	170	010	190	210	030
105	285	066	246	355	175	015	195	215	035
110	290	071	251	000	180	020	200	220	040
115	295	076	256	005	185	025	205	225	045
120	300	081	261	010	190	030	210	230	050
125	305	086	266	015	195	035	215	235	055
130	310	091	271	020	200	040	220	240	060
135	315	096	276	025	205	045	225	245	065
140	320	101	281	030	210	050	230	250	070
145	325	106	286	035	215	055	235	255	075
150	330	111	291	040	220	060	240	260	080
155	335	116	296	045	225	065	245	265	085
160	340	121	301	050	230	070	250	270	090
165	345	126	306	055	235	075	255	275	095
170	350	131	311	060	240	080	260	280	100
175	355	136	316	065	245	085	265	285	105

Course Axis	Angles in Degrees								
4 - 1	1 - 4	4 - 2	2 - 4	4 - 3	3 - 4	Signal	Pin -	3 -	Finish
3 - 2	2 - 3			1 - 2	2 - 1	- Pin	Signal	Finish	- 3
180	360	141	321	070	250	090	270	290	110
185	005	146	326	075	255	095	275	295	115
190	010	151	331	080	260	100	280	300	120
195	015	156	336	085	265	105	285	305	125
200	020	161	341	090	270	110	290	310	130
205	025	166	346	095	275	115	295	315	135
210	030	171	351	100	280	120	300	320	140
215	035	176	356	105	285	125	305	325	145
220	040	181	001	110	290	130	310	330	150
225	045	186	006	115	295	135	315	335	155
230	050	191	011	120	300	140	320	340	160
235	055	196	016	125	305	145	325	345	165
240	060	201	021	130	310	150	330	350	170
245	065	206	026	135	315	155	335	355	175
250	070	211	031	140	320	160	340	000	180
255	075	216	036	145	325	165	345	005	185
260	080	221	041	150	330	170	350	010	190
265	085	226	046	155	335	175	355	015	195
270	090	231	051	160	340	180	000	020	200
275	095	236	056	165	345	185	005	025	205
280	100	241	061	170	350	190	010	030	210
285	105	246	066	175	355	195	015	035	215
290	110	251	071	180	000	200	020	040	220
295	115	256	076	185	005	205	025	045	225
300	120	261	081	190	010	210	030	050	230
305	125	266	086	195	015	215	035	055	235
310	130	271	091	200	020	220	040	060	240
315	135	276	096	205	025	225	045	065	245
320	140	281	101	210	030	230	050	070	250
325	145	286	106	215	035	235	055	075	255
330	150	291	111	220	040	240	060	080	260
335	155	296	116	225	045	245	065	085	265
340	160	301	121	230	050	250	070	090	270
345	165	306	126	235	055	255	075	095	275
350	170	311	131	240	060	260	080	100	280
355	175	316	136	245	065	265	085	105	285

Trapezoid Course 70°, 110° interior angles. Reach = 2/3 beat length

Leg lengths		
4 - 1 & 1 - 4	4 - 2 & 2 - 4	1 - 2 & 2 - 1
2 - 3 & 3 - 2		4 - 3 & 3 - 4
0.20	0.20	0.13
0.25	0.25	0.17
0.30	0.30	0.20
0.35	0.35	0.23
0.40	0.40	0.27
0.45	0.45	0.30
0.50	0.50	0.33
0.55	0.55	0.37
0.60	0.60	0.40
0.65	0.65	0.43
0.70	0.70	0.47
0.75	0.75	0.50
0.80	0.80	0.53
0.85	0.85	0.57
0.90	0.89	0.60
0.95	0.94	0.63
1.00	0.99	0.67
1.10	1.09	0.73
1.20	1.19	0.80
1.30	1.29	0.87
1.40	1.39	0.93
1.50	1.49	1.00
1.60	1.59	1.07
1.70	1.69	1.13
1.80	1.79	1.20
1.90	1.89	1.27
2.00	1.99	1.33

Course Distances		
I2	I3	I4
O2	O3	O4
1.13	1.53	1.93
1.37	1.87	2.37
1.60	2.20	2.80
1.83	2.53	3.23
2.07	2.87	3.67
2.30	3.20	4.10
2.53	3.53	4.53
2.77	3.87	4.97
3.00	4.20	5.40
3.23	4.53	5.83
3.47	4.87	6.27
3.70	5.20	6.70
3.93	5.53	7.13
4.17	5.87	7.57
4.40	6.20	8.00
4.63	6.53	8.43
4.87	6.87	8.87
5.33	7.53	9.73
5.80	8.20	10.60
6.27	8.87	11.47
6.73	9.53	12.33
7.20	10.20	13.20
7.67	10.87	14.07
8.13	11.53	14.93
8.60	12.20	15.80
9.07	12.87	16.67
9.53	13.53	17.53



- I2 Start - 1 - 4s/4p - 1 - 2 - 3p - Finish
- I3 Start - 1 - 4s/4p - 1 - 4s/4p - 1 - 2 - 3p - Finish
- I4 Start - 1 - 4s/4p - 1 - 4s/4p - 1 - 4s/4p - 1 - 2 - 3p - Finish
- O2 Start - 1 - 2 - 3s/3p - 2 - 3p - Finish
- O3 Start - 1 - 2 - 3s/3p - 2 - 3s/3p - 2 - 3p - Finish
- O4 Start - 1 - 2 - 3s/3p - 2 - 3s/3p - 2 - 3s/3p - 2 - 3p - Finish

Laser and Laser Radial Trapezoid Course 70°, 110° interior angles

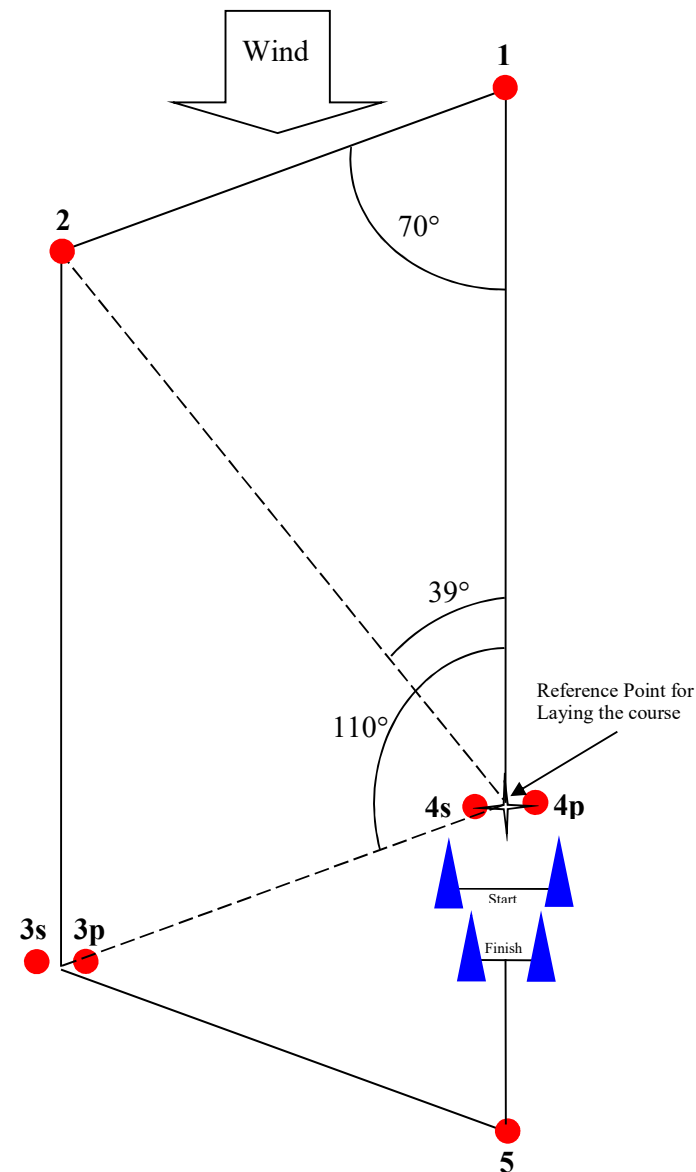
Course Axis	<i>Trapezoid Course 70, 110 interior angles</i>								
4 - 1 3 - 2 5 - F	1 - 4 2 - 3 F - 5	4 - 2	2 - 4	4 - 3 1 - 2	3 - 4 2 - 1	3 - 5	5 - 3	Signal - Pin	Pin - Signal
000	180	321	141	250	070	110	290	270	090
005	185	326	146	255	075	115	295	275	095
010	190	331	151	260	080	120	300	280	100
015	195	336	156	265	085	125	305	285	105
020	200	341	161	270	090	130	310	290	110
025	205	346	166	275	095	135	315	295	115
030	210	351	171	280	100	140	320	300	120
035	215	356	176	285	105	145	325	305	125
040	220	001	181	290	110	150	330	310	130
045	225	006	186	295	115	155	335	315	135
050	230	011	191	300	120	160	340	320	140
055	235	016	196	305	125	165	345	325	145
060	240	021	201	310	130	170	350	330	150
065	245	026	206	315	135	175	355	335	155
070	250	031	211	320	140	180	000	340	160
075	255	036	216	325	145	185	005	345	165
080	260	041	221	330	150	190	010	350	170
085	265	046	226	335	155	195	015	355	175
090	270	051	231	340	160	200	020	000	180
095	275	056	236	345	165	205	025	005	185
100	280	061	241	350	170	210	030	010	190
105	285	066	246	355	175	215	035	015	195
110	290	071	251	000	180	220	040	020	200
115	295	076	256	005	185	225	045	025	205
120	300	081	261	010	190	230	050	030	210
125	305	086	266	015	195	235	055	035	215
130	310	091	271	020	200	240	060	040	220
135	315	096	276	025	205	245	065	045	225
140	320	101	281	030	210	250	070	050	230
145	325	106	286	035	215	255	075	055	235
150	330	111	291	040	220	260	080	060	240
155	335	116	296	045	225	265	085	065	245
160	340	121	301	050	230	270	090	070	250
165	345	126	306	055	235	275	095	075	255
170	350	131	311	060	240	280	100	080	260
175	355	136	316	065	245	285	105	085	265

Course Axis									
4 - 1 3 - 2 5 - F	1 - 4 2 - 3 F - 5	4 - 2	2 - 4	4 - 3 1 - 2	3 - 4 2 - 1	3 - 5	5 - 3	Signal - Pin	Pin - Signal
180	360	141	321	070	250	290	110	090	270
185	005	146	326	075	255	295	115	095	275
190	010	151	331	080	260	300	120	100	280
195	015	156	336	085	265	305	125	105	285
200	020	161	341	090	270	310	130	110	290
205	025	166	346	095	275	315	135	115	295
210	030	171	351	100	280	320	140	120	300
215	035	176	356	105	285	325	145	125	305
220	040	181	001	110	290	330	150	130	310
225	045	186	006	115	295	335	155	135	315
230	050	191	011	120	300	340	160	140	320
235	055	196	016	125	305	345	165	145	325
240	060	201	021	130	310	350	170	150	330
245	065	206	026	135	315	355	175	155	335
250	070	211	031	140	320	000	180	160	340
255	075	216	036	145	325	005	185	165	345
260	080	221	041	150	330	010	190	170	350
265	085	226	046	155	335	015	195	175	355
270	090	231	051	160	340	020	200	180	000
275	095	236	056	165	345	025	205	185	005
280	100	241	061	170	350	030	210	190	010
285	105	246	066	175	355	035	215	195	015
290	110	251	071	180	000	040	220	200	020
295	115	256	076	185	005	045	225	205	025
300	120	261	081	190	010	050	230	210	030
305	125	266	086	195	015	055	235	215	035
310	130	271	091	200	020	060	240	220	040
315	135	276	096	205	025	065	245	225	045
320	140	281	101	210	030	070	250	230	050
325	145	286	106	215	035	075	255	235	055
330	150	291	111	220	040	080	260	240	060
335	155	296	116	225	045	085	265	245	065
340	160	301	121	230	050	090	270	250	070
345	165	306	126	235	055	095	275	255	075
350	170	311	131	240	060	100	280	260	080
355	175	316	136	245	065	105	285	265	085

**Laser and Laser Radial 70° Trapezoid Course Lengths to Marks and Course Lengths – Equal beats, Reaches (1-2 and 3-5) two thirds of beat length
Start 0.05 nt mi downwind of 4S/4P(4)**

4 - 1 & 1 - 4 2 - 3 & 3 - 2	4 - 2 & 2 - 4	1 - 2 & 2 - 1 4 - 3 & 3 - 4	4 - 5 5 - 4	5 - F F - 5	IW2 OW2	IW3 OW3
0.20	0.20	0.13	0.10	0.10	1.21	1.61
0.25	0.25	0.17	0.11	0.10	1.49	1.99
0.30	0.30	0.20	0.14	0.10	1.75	2.35
0.35	0.35	0.23	0.16	0.10	2.01	2.71
0.40	0.40	0.27	0.18	0.10	2.29	3.09
0.45	0.45	0.30	0.21	0.10	2.55	3.45
0.50	0.50	0.33	0.23	0.10	2.81	3.81
0.55	0.55	0.37	0.25	0.10	3.09	4.19
0.60	0.60	0.40	0.27	0.12	3.37	4.57
0.65	0.65	0.43	0.3	0.15	3.66	4.96
0.70	0.70	0.47	0.32	0.17	3.96	5.36
0.75	0.75	0.50	0.34	0.19	4.24	5.74
0.80	0.80	0.53	0.36	0.21	4.52	6.12
0.85	0.85	0.57	0.39	0.24	4.83	6.53
0.90	0.89	0.60	0.41	0.26	5.11	6.91
0.95	0.94	0.63	0.43	0.28	5.39	7.29
1.00	0.99	0.67	0.46	0.31	5.7	7.7
1.10	1.09	0.73	0.5	0.35	6.26	8.46
1.20	1.19	0.80	0.55	0.4	6.85	9.25
1.30	1.29	0.87	0.59	0.44	7.43	10.03
1.40	1.39	0.93	0.64	0.49	8	10.8
1.50	1.49	1.00	0.68	0.53	8.58	11.58
1.60	1.59	1.07	0.73	0.58	9.17	12.37
1.70	1.69	1.13	0.78	0.63	9.74	13.14
1.80	1.79	1.20	0.82	0.67	10.32	13.92
1.90	1.89	1.27	0.87	0.72	10.91	14.71
2.00	1.99	1.33	0.91	0.76	11.47	15.47

IW2 Start – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW3 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW4 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
OW2 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 5 – Finish
OW3 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW4 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish



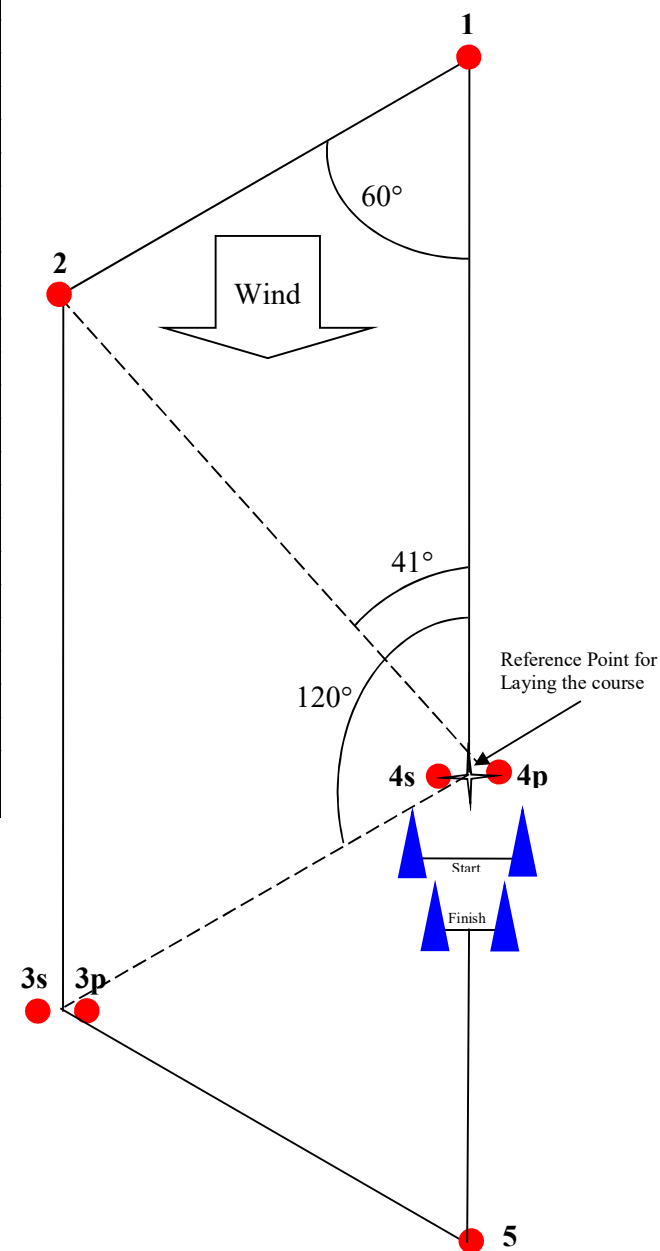
Trapezoid Course with windward finish 60°, 120° interior angles

Course Axis	Trapezoid Course 60, 120 interior angles								
4 - 1 3 - 2 5 - F	1 - 4 2 - 3 F - 5	4 - 2	2 - 4	4 - 3 1 - 2	3 - 4 2 - 1	3 - 5	5 - 3	Signal - Pin	Pin - Signal
000	180	319	139	240	060	120	300	270	090
005	185	324	144	245	065	125	305	275	095
010	190	329	149	250	070	130	310	280	100
015	195	334	154	255	075	135	315	285	105
020	200	339	159	260	080	140	320	290	110
025	205	344	164	265	085	145	325	295	115
030	210	349	169	270	090	150	330	300	120
035	215	354	174	275	095	155	335	305	125
040	220	359	179	280	100	160	340	310	130
045	225	004	184	285	105	165	345	315	135
050	230	009	189	290	110	170	350	320	140
055	235	014	194	295	115	175	355	325	145
060	240	019	199	300	120	180	000	330	150
065	245	024	204	305	125	185	005	335	155
070	250	029	209	310	130	190	010	340	160
075	255	034	214	315	135	195	015	345	165
080	260	039	219	320	140	200	020	350	170
085	265	044	224	325	145	205	025	355	175
090	270	049	229	330	150	210	030	000	180
095	275	054	234	335	155	215	035	005	185
100	280	059	239	340	160	220	040	010	190
105	285	064	244	345	165	225	045	015	195
110	290	069	249	350	170	230	050	020	200
115	295	074	254	355	175	235	055	025	205
120	300	079	259	000	180	240	060	030	210
125	305	084	264	005	185	245	065	035	215
130	310	089	269	010	190	250	070	040	220
135	315	094	274	015	195	255	075	045	225
140	320	099	279	020	200	260	080	050	230
145	325	104	284	025	205	265	085	055	235
150	330	109	289	030	210	270	090	060	240
155	335	114	294	35	215	275	095	065	245
160	340	119	299	40	220	280	100	070	250
165	345	124	304	45	225	285	105	075	255
170	350	129	309	50	230	290	110	080	260
175	355	134	314	55	235	295	115	085	265

Course Axis									
4 - 1 3 - 2 5 - F	1 - 4 2 - 3 F - 5	4 - 2	2 - 4	4 - 3 1 - 2	3 - 4 2 - 1	3 - 5	5 - 3	Signal - Pin	Pin - Signal
180	000	139	319	060	240	300	120	090	270
185	005	144	324	065	245	305	125	095	275
190	010	149	329	070	250	310	130	100	280
195	015	154	334	075	255	315	135	105	285
200	020	159	339	080	260	320	140	110	290
205	025	164	344	085	265	325	145	115	295
210	030	169	349	090	270	330	150	120	300
215	035	174	354	095	275	335	155	125	305
220	040	179	359	100	280	340	160	130	310
225	045	184	004	105	285	345	165	135	315
230	050	189	009	110	290	350	170	140	320
235	055	194	014	115	295	355	175	145	325
240	060	199	019	120	300	000	180	150	330
245	065	204	024	125	305	005	185	155	335
250	070	209	029	130	310	010	190	160	340
255	075	214	034	135	315	015	195	165	345
260	080	219	039	140	320	020	200	170	350
265	085	224	044	145	325	025	205	175	355
270	090	229	049	150	330	030	210	180	000
275	095	234	054	155	335	035	215	185	005
280	100	239	059	160	340	040	220	190	010
285	105	244	064	165	345	045	225	195	015
290	110	249	069	170	350	050	230	200	020
295	115	254	074	175	355	055	235	205	025
300	120	259	079	180	000	060	240	210	030
305	125	264	084	185	005	065	245	215	035
310	130	269	089	190	010	070	250	220	040
315	135	274	094	195	015	075	255	225	045
320	140	279	099	200	020	080	260	230	050
325	145	284	104	205	025	085	265	235	055
330	150	289	109	210	030	090	270	240	060
335	155	294	114	215	035	095	275	245	065
340	160	299	119	220	040	100	280	250	070
345	165	304	124	225	045	105	285	255	075
350	170	309	129	230	050	110	290	260	080
355	175	314	134	235	055	115	295	265	085

60° Trapezoid with windward finish Course Lengths to Marks and Course Lengths – Equal beats, Reaches (1-2 and 3-5) two thirds of beat length
Start 0.05 NM downwind of 4S/4P(4) Finish 0.1 NM below the starting line

4 - 1 & 1 - 4	4 - 2 & 2 - 4	1 - 2 & 2 - 1	4 - 5	5 - F	IW2	IW3	IW4
2 - 3 & 3 - 2		4 - 3 & 3 - 4	5 - 4	F - 5	OW2	OW3	OW4
0.40	0.35	0.27	0.27	0.12	2.31	4.31	6.31
0.45	0.40	0.30	0.30	0.15	2.6	4.6	6.6
0.50	0.44	0.33	0.33	0.18	2.89	4.89	6.89
0.55	0.48	0.37	0.37	0.22	3.21	5.21	7.21
0.60	0.53	0.40	0.40	0.25	3.5	5.5	7.5
0.65	0.57	0.43	0.43	0.28	3.79	5.79	7.79
0.70	0.62	0.47	0.47	0.32	4.11	6.11	8.11
0.75	0.66	0.50	0.50	0.35	4.4	6.4	8.4
0.80	0.70	0.53	0.53	0.38	4.69	6.69	8.69
0.85	0.75	0.57	0.57	0.42	5.01	7.01	9.01
0.90	0.79	0.60	0.60	0.45	5.3	7.3	9.3
0.95	0.84	0.63	0.63	0.48	5.59	7.59	9.59
1.00	0.88	0.67	0.67	0.52	5.91	7.91	9.91
1.10	0.97	0.73	0.73	0.12	6.49	8.49	10.49
1.20	1.06	0.80	0.80	0.15	7.1	9.1	11.1
1.30	1.14	0.87	0.87	0.18	7.71	9.71	11.71
1.40	1.23	0.93	0.93	0.22	8.29	10.29	12.29
1.50	1.32	1.00	1.00	0.25	8.9	10.9	12.9
1.60	1.41	1.07	1.07	0.28	9.51	11.51	13.51
1.70	1.50	1.13	1.13	0.32	10.09	12.09	14.09
1.80	1.58	1.20	1.20	0.35	10.7	12.7	14.7
1.90	1.67	1.27	1.27	0.38	11.31	13.31	15.31
2.00	1.76	1.33	1.33	0.42	11.89	13.89	15.89



IW2 Start – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW3 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish
IW4 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – 2 – 3p – 5 – Finish

OW2 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 5 – Finish
OW3 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish
OW4 Start – 1 – 2 – 3s/3p – 2 – 3s/3p – 2 – 3s/3p – 2 – 3p – 5 – Finish

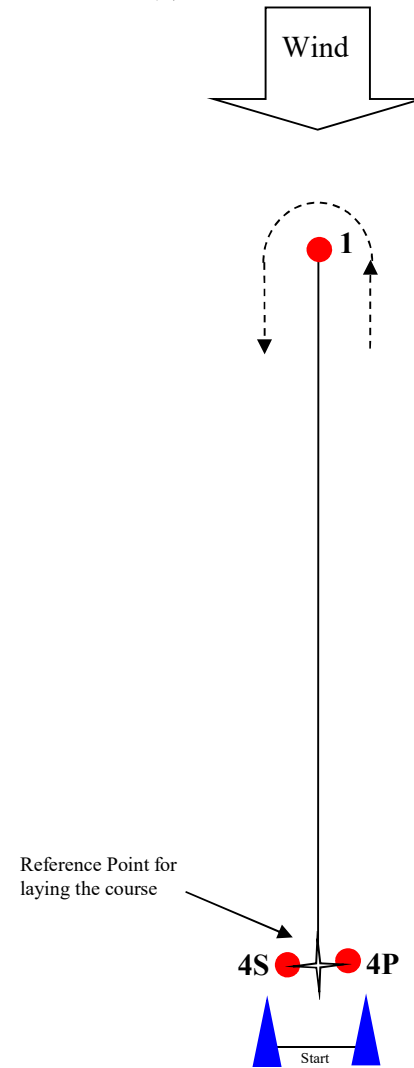
Windward-leeward courses

Course Axis				Course Axis			
4 - 1	1 - 4	Signal - Pin	Pin - Signal	4 - 1	1 - 4	Signal - Pin	Pin - Signal
000	180	270	090	180	000	090	270
005	185	275	095	185	005	095	275
010	190	280	100	190	010	100	280
015	195	285	105	195	015	105	285
020	200	290	110	200	020	110	290
025	205	295	115	205	025	115	295
030	210	300	120	210	030	120	300
035	215	305	125	215	035	125	305
040	220	310	130	220	040	130	310
045	225	315	135	225	045	135	315
050	230	320	140	230	050	140	320
055	235	325	145	235	055	145	325
060	240	330	150	240	060	150	330
065	245	335	155	245	065	155	335
070	250	340	160	250	070	160	340
075	255	345	165	255	075	165	345
080	260	350	170	260	080	170	350
085	265	355	175	265	085	175	355
090	270	000	180	270	090	180	000
095	275	005	185	275	095	185	005
100	280	010	190	280	100	190	010
105	285	015	195	285	105	195	015
110	290	020	200	290	110	200	020
115	295	025	205	295	115	205	025
120	300	030	210	300	120	210	030
125	305	035	215	305	125	215	035
130	310	040	220	310	130	220	040
135	315	045	225	315	135	225	045
140	320	050	230	320	140	230	050
145	325	055	235	325	145	235	055
150	330	060	240	330	150	240	060
155	335	065	245	335	155	245	065
160	340	070	250	340	160	250	070
165	345	075	255	345	165	255	075
170	350	080	260	350	170	260	080
175	355	085	265	355	175	265	085

Windward-leeward Course Lengths to Marks and Course Lengths
Start/Finish 0.05 nt mi downwind of mark 4S/4P (4)

Leg Length	Course Distances			
	L1	L2	L3	L4
4 - 1				
1 - 4				
0.50	1.10	2.10	3.10	4.10
0.60	1.30	2.50	3.70	4.90
0.70	1.50	2.90	4.30	5.70
0.80	1.70	3.30	4.90	6.50
0.90	1.90	3.70	5.50	7.30
1.00	2.10	4.10	6.10	8.10
1.10	2.30	4.50	6.70	8.90
1.20	2.50	4.90	7.30	9.70
1.30	2.70	5.30	7.90	10.50
1.40	2.90	5.70	8.50	11.30
1.50	3.10	6.10	9.10	12.10
1.60	3.30	6.50	9.70	13.90
1.70	3.50	6.90	10.30	13.70
1.80	3.70	7.30	10.90	14.50
1.90	3.90	7.70	11.50	15.30
2.00	4.10	8.10	12.10	16.10
2.10	4.30	8.50	12.70	16.90
2.20	4.50	8.90	13.30	17.70
2.30	4.70	9.30	13.90	18.50
2.40	4.90	9.70	14.50	19.30
2.50	5.10	10.10	15.10	20.10
2.60	5.30	10.50	15.70	20.90
2.70	5.50	10.90	16.30	21.70
2.80	5.70	11.30	16.90	22.50
2.90	5.90	11.70	17.50	23.30
3.00	6.10	12.10	18.10	24.10

<p>L1 Start – 1 – Finish L2 Start – 1 – 4S/4P – 1 – Finish L3 Start – 1 – 4S/4P – 1 – 4S/4P – 1 – Finish L4 Start – 1 – 4S/4P – 1 – 4S/4P – 1 – 4S/4P – 1 – Finish</p>



Windward-leeward courses with 80° offset mark 1A

Course Axis					
4 – 1A	1A - 4	1 - 1A	1A - 1	Signal	Pin -
				- Pin	Signal
000	180	280	100	270	090
005	185	285	105	275	095
010	190	290	110	280	100
015	195	295	115	285	105
020	200	300	120	290	110
025	205	305	125	295	115
030	210	310	130	300	120
035	215	315	135	305	125
040	220	320	140	310	130
045	225	325	145	315	135
050	230	330	150	320	140
055	235	335	155	325	145
060	240	340	160	330	150
065	245	345	165	335	155
070	250	350	170	340	160
075	255	355	175	345	165
080	260	000	180	350	170
085	265	005	185	355	175
090	270	010	190	000	180
095	275	015	195	005	185
100	280	020	200	010	190
105	285	025	205	015	195
110	290	030	210	020	200
115	295	035	215	025	205
120	300	040	220	030	210
125	305	045	225	035	215
130	310	050	230	040	220
135	315	055	235	045	225
140	320	060	240	050	230
145	325	065	245	055	235
150	330	070	250	060	240
155	335	075	255	065	245
160	340	080	260	070	250
165	345	085	265	075	255
170	350	090	270	080	260
175	355	095	275	085	265

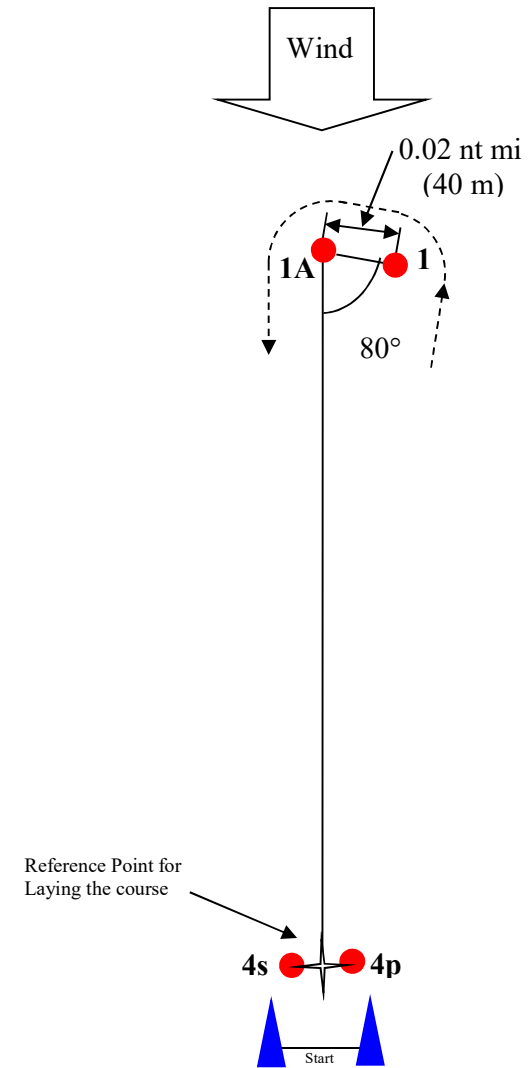
Course Axis					
4 – 1A	1A - 4	1 - 1A	1A - 1	Signal	Pin -
				- Pin	Signal
180	000	100	280	090	270
185	005	105	285	095	275
190	010	110	290	100	280
195	015	115	295	105	285
200	020	120	300	110	290
205	025	125	305	115	295
210	030	130	310	120	300
215	035	135	315	125	305
220	040	140	320	130	310
225	045	145	325	135	315
230	050	150	330	140	320
235	055	155	335	145	325
240	060	160	340	150	330
245	065	165	345	155	335
250	070	170	350	160	340
255	075	175	355	165	345
260	080	180	000	170	350
265	085	185	005	175	355
270	090	190	010	180	000
275	095	195	015	185	005
280	100	200	020	190	010
285	105	205	025	195	015
290	110	210	030	200	020
295	115	215	035	205	025
300	120	220	040	210	030
305	125	225	045	215	035
310	130	230	050	220	040
315	135	235	055	225	045
320	140	240	060	230	050
325	145	245	065	235	055
330	150	250	070	240	060
335	155	255	075	245	065
340	160	260	080	250	070
345	165	265	085	255	075
350	170	270	090	260	080
355	175	275	095	265	085

Windward-leeward courses with 80° offset mark 1A

Leg lengths	
4 - 1	1 - 1A
1 - 4	1A - 1
0.50	0.02
0.60	0.02
0.70	0.02
0.80	0.02
0.90	0.02
1.00	0.02
1.10	0.02
1.20	0.02
1.30	0.02
1.40	0.02
1.50	0.02
1.60	0.02
1.70	0.02
1.80	0.02
1.90	0.02
2.00	0.02
2.10	0.02
2.20	0.02
2.30	0.02
2.40	0.02
2.50	0.02
2.60	0.02
2.70	0.02
2.80	0.02
2.90	0.02
3.00	0.02

Course Distances			
L1	L2	L3	L4
1.12	2.14	3.16	4.18
1.32	2.54	3.76	4.98
1.52	2.94	4.36	5.78
1.72	3.34	4.96	6.58
1.92	3.74	5.56	7.38
2.12	4.14	6.16	8.18
2.32	4.54	6.76	8.98
2.52	4.94	7.36	9.78
2.72	5.34	7.96	10.58
2.92	5.74	8.56	11.38
3.12	6.14	9.16	12.18
3.32	6.54	9.76	12.98
3.52	6.94	10.36	13.78
3.72	7.34	10.96	14.58
3.92	7.74	11.56	15.38
4.12	8.14	12.16	16.18
4.32	8.54	12.76	16.98
4.52	8.94	13.36	17.78
4.72	9.34	13.96	18.58
4.92	9.74	14.56	19.38
5.12	10.14	15.16	20.18
5.32	10.54	15.76	20.98
5.52	10.94	16.36	21.78
5.72	11.34	16.96	22.58
5.92	11.74	17.56	23.38
6.12	12.14	18.16	24.18

- L1 Start – 1 – Finish
- L2 Start – 1 – 4s/4p – 1 – Finish
- L3 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – Finish
- L4 Start – 1 – 4s/4p – 1 – 4s/4p – 1 – 4s/4p – 1 – Finish



45°, 90°, 45° Triangular course with start finish in the middle of the beat.

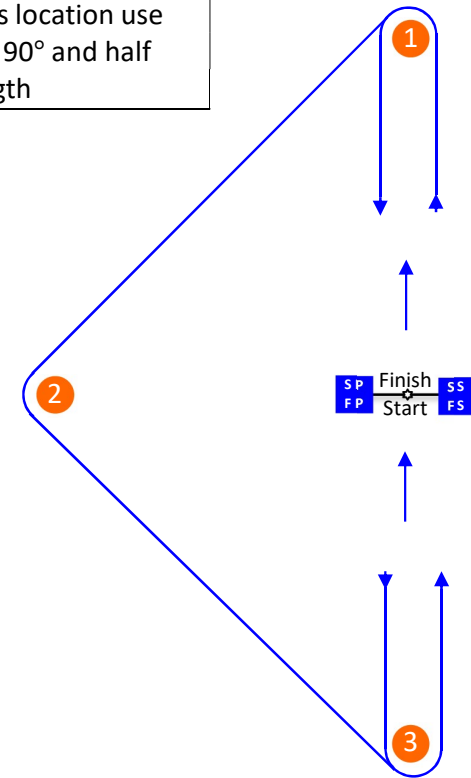
R - 1 3 - R	1 - R R - 3	R - 2 S - Pin	2 - R Pin - S	R - 1 3 - R	1 - R R - 3	R - 2 S - Pin	2 - R Pin - S
000	180	270	090	180	000	090	270
005	185	275	095	185	005	095	275
010	190	280	100	190	010	100	280
015	195	285	105	195	015	105	285
020	200	290	110	200	020	110	290
025	205	295	115	205	025	115	295
030	210	300	120	210	030	120	300
035	215	305	125	215	035	125	305
040	220	310	130	220	040	130	310
045	225	315	135	225	045	135	315
050	230	320	140	230	050	140	320
055	235	325	145	235	055	145	325
060	240	330	150	240	060	150	330
065	245	335	155	245	065	155	335
070	250	340	160	250	070	160	340
075	255	345	165	255	075	165	345
080	260	350	170	260	080	170	350
085	265	355	175	265	085	175	355
090	270	000	180	270	090	180	000
095	275	005	185	275	095	185	005
100	280	010	190	280	100	190	010
105	285	015	195	285	105	195	015
110	290	020	200	290	110	200	020
115	295	025	205	295	115	205	025
120	300	030	210	300	120	210	030
125	305	035	215	305	125	215	035
130	310	040	220	310	130	220	040
135	315	045	225	315	135	225	045
140	320	050	230	320	140	230	050
145	325	055	235	325	145	235	055
150	330	060	240	330	150	240	060
155	335	065	245	335	155	245	065
160	340	070	250	340	160	250	070
165	345	075	255	345	165	255	075
170	350	080	260	350	170	260	080
175	355	085	265	355	175	265	085

45°, 90°, 45° Triangular course with start finish in the middle of the beat.

R - 1 1 - R R - 3 3 - R	R - 2 2 - R	1 - 2 2 - 1 3 - 2 2 - 3
0.20	0.20	0.28
0.25	0.25	0.35
0.30	0.30	0.42
0.35	0.35	0.49
0.40	0.40	0.57
0.45	0.45	0.64
0.50	0.50	0.71
0.55	0.55	0.78
0.60	0.60	0.85
0.65	0.65	0.92
0.70	0.70	0.99
0.75	0.75	1.06
0.80	0.80	1.13
0.85	0.85	1.20
0.90	0.90	1.27
0.95	0.95	1.34
1.00	1.00	1.41
1.05	1.05	1.48
1.10	1.10	1.56
1.15	1.15	1.63
1.20	1.20	1.70
1.25	1.25	1.77
1.30	1.30	1.84
1.35	1.35	1.91
1.40	1.40	1.98
1.45	1.45	2.05
1.50	1.50	2.12

T1	T2	T3
0.96	1.76	2.72
1.20	2.20	3.40
1.44	2.64	4.08
1.68	3.08	4.76
1.94	3.54	5.48
2.18	3.98	6.16
2.42	4.42	6.84
2.66	4.86	7.52
2.90	5.30	8.20
3.14	5.74	8.88
3.38	6.18	9.56
3.62	6.62	10.24
3.86	7.06	10.92
4.10	7.50	11.60
4.34	7.94	12.28
4.58	8.38	12.96
4.82	8.82	13.64
5.06	9.26	14.32
5.32	9.72	15.04
5.56	10.16	15.72
5.80	10.60	16.40
6.04	11.04	17.08
6.28	11.48	17.76
6.52	11.92	18.44
6.76	12.36	19.12
7.00	12.80	19.80
7.24	13.24	20.48

R, the reference point, is the middle of the starting line.
For projecting its location use wind axis minus 90° and half starting line length



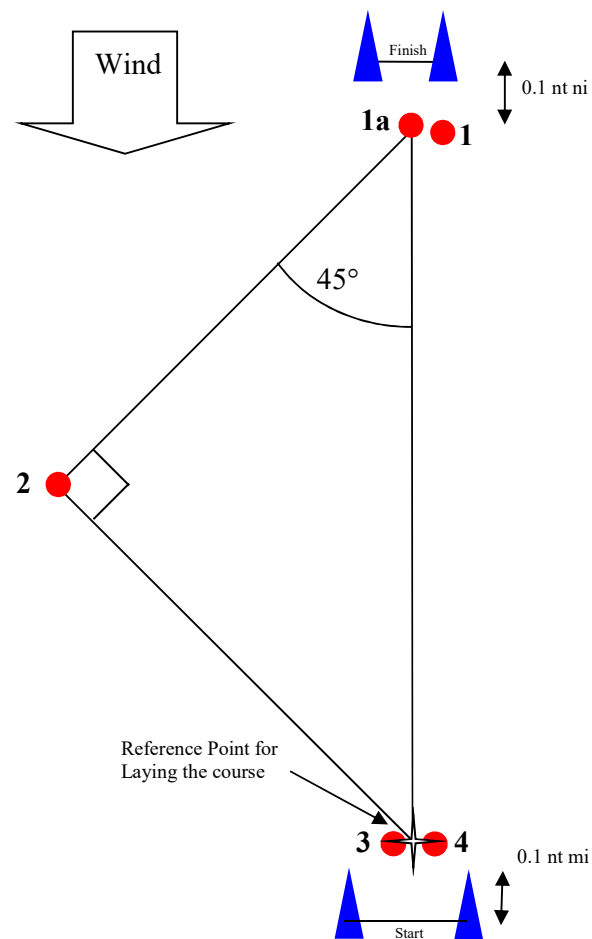
T1	Start – 1 – 2 – 3 – Finish
T2	Start – 1 – 2 – 3 – 1 - 3 - Finish
T3	Start – 1 – 2 – 3 – 1 – 3 – 1 – 2 - 3 Finish

45°, 90°, 45° Triangular Course Used for OK Worlds 2010
Start 0.1 NM downwind of mark 3/4 and Finish 0.1 NM above Mark 1

Course Axis	Angles in Degrees							Course Axis	Angle in Degrees								
	Start to 1	1 to 3	3 to 2	2 to 3	1 to 2	2 to 1	Start (Finish) to Pin (FP)		Pin (FP) to Start (Finish)	Start to 1	1 to 3	3 to 2	2 to 3	1 to 2	2 to 1	Start (Finish) to Pin (FP)	Pin (FP) to Start (Finish)
000	180	315	135	225	045	270	090	180	000	135	315	045	225	090	270	090	
005	185	320	140	230	050	275	095	185	005	140	320	050	230	095	275	095	
010	190	325	145	235	055	280	100	190	010	145	325	055	235	100	280	100	
015	195	330	150	240	060	285	105	195	015	150	330	060	240	105	285	105	
020	200	335	155	245	065	290	110	200	020	155	335	065	245	110	290	110	
025	205	340	160	250	070	295	115	205	025	160	340	070	250	115	295	115	
030	210	345	165	255	075	300	120	210	030	165	345	075	255	120	300	120	
035	215	350	170	260	080	305	125	215	035	170	350	080	260	125	305	125	
040	220	355	175	265	085	310	130	220	040	175	355	085	265	130	310	130	
045	225	000	180	270	090	315	135	225	045	180	000	090	270	135	315	135	
050	230	005	185	275	095	320	140	230	050	185	005	095	275	140	320	140	
055	235	010	190	280	100	325	145	235	055	190	010	100	280	145	325	145	
060	240	015	195	285	105	330	150	240	060	195	015	105	285	150	330	150	
065	245	020	200	290	110	335	155	245	065	200	020	110	290	155	335	155	
070	250	025	205	295	115	340	160	250	070	205	025	115	295	160	340	160	
075	255	030	210	300	120	345	165	255	075	210	030	120	300	165	345	165	
080	260	035	215	305	125	350	170	260	080	215	035	125	305	170	350	170	
085	265	040	220	310	130	355	175	265	085	220	040	130	310	175	355	175	
090	270	045	225	315	135	000	180	270	090	225	045	135	315	180	000	180	
095	275	050	230	320	140	005	185	275	095	230	050	140	320	185	005	185	
100	280	055	235	325	145	010	190	280	100	235	055	145	325	190	010	190	
105	285	060	240	330	150	015	195	285	105	240	060	150	330	195	015	195	
110	290	065	245	335	155	020	200	290	110	245	065	155	335	200	020	200	
115	295	070	250	340	160	025	205	295	115	250	070	160	340	205	025	205	
120	300	075	255	345	165	030	210	300	120	255	075	165	345	210	030	210	
125	305	080	260	350	170	035	215	305	125	260	080	170	350	215	035	215	
130	310	085	265	355	175	040	220	310	130	265	085	175	355	220	040	220	
135	315	090	270	000	180	045	225	315	135	270	090	180	000	225	045	225	
140	320	095	275	005	185	050	230	320	140	275	095	185	005	230	050	230	
145	325	100	280	010	190	055	235	325	145	280	100	190	010	235	055	235	
150	330	105	285	015	195	060	240	330	150	285	105	195	015	240	060	240	
155	335	110	290	020	200	065	245	335	155	290	110	200	020	245	065	245	
160	340	115	295	025	205	070	250	340	160	295	115	205	025	250	070	250	
165	345	120	300	030	210	075	255	345	165	300	120	210	030	255	075	255	
170	350	125	305	035	215	080	260	350	170	305	125	215	035	260	080	260	
175	355	130	310	040	220	085	265	355	175	310	130	220	040	265	085	265	

45°, 90°, 45° Triangular Course Used for OK Worlds 2010
Start 0.1 NM downwind of mark 3/4 and Finish 0.1 NM above Mark 1

Leg lengths				Total Course Distance
3 to 1 1 to 3	3 to 2 2 to 3	1 to 2 2 to 1	Finish to 3	
0.4	0.28	0.28	0.5	2.36
0.45	0.32	0.32	0.55	2.64
0.5	0.35	0.35	0.6	2.9
0.55	0.39	0.39	0.65	3.18
0.6	0.42	0.42	0.7	3.44
0.65	0.46	0.46	0.75	3.72
0.7	0.49	0.49	0.8	3.98
0.75	0.53	0.53	0.85	4.26
0.8	0.57	0.57	0.9	4.54
0.85	0.6	0.6	0.95	4.8
0.9	0.64	0.64	1	5.08
0.95	0.67	0.67	1.05	5.34
1	0.71	0.71	1.1	5.62
1.05	0.74	0.74	1.15	5.88
1.1	0.78	0.78	1.2	6.16
1.15	0.81	0.81	1.25	6.42
1.2	0.85	0.85	1.3	6.7
1.25	0.88	0.88	1.35	6.96
1.3	0.92	0.92	1.4	7.24
1.35	0.95	0.95	1.45	7.5
1.4	0.99	0.99	1.5	7.78
1.45	1.03	1.03	1.55	8.06
1.5	1.06	1.06	1.6	8.32
1.55	1.1	1.1	1.65	8.6
1.6	1.13	1.13	1.7	8.86
1.65	1.17	1.17	1.75	9.14
1.7	1.2	1.2	1.8	9.4
1.75	1.24	1.24	1.85	9.68
1.8	1.27	1.27	1.9	9.94
1.85	1.31	1.31	1.95	10.22
1.9	1.34	1.34	2	10.48
1.95	1.38	1.38	2.05	10.76
2	1.41	1.41	2.1	11.02



Course
Start – 1 – 1a – 2 – 3 – 1 – 1a – 3/4 – Finish

45°, 90°, 45° Triangular Course
Start/Finish 0.05 NM downwind of mark 3 or Finish 0.05 NM upwind of Mark 1

Course Axis	Angles ind degrees						
	3 to 1	1 to 3	3 to 2	2 to 3	1 to 2	2 to 1	Signal to Pin
000	180	315	135	225	045	270	090
005	185	320	140	230	050	275	095
010	190	325	145	235	055	280	100
015	195	330	150	240	060	285	105
020	200	335	155	245	065	290	110
025	205	340	160	250	070	295	115
030	210	345	165	255	075	300	120
035	215	350	170	260	080	305	125
040	220	355	175	265	085	310	130
045	225	000	180	270	090	315	135
050	230	005	185	275	095	320	140
055	235	010	190	280	100	325	145
060	240	015	195	285	105	330	150
065	245	020	200	290	110	335	155
070	250	025	205	295	115	340	160
075	255	030	210	300	120	345	165
080	260	035	215	305	125	350	170
085	265	040	220	310	130	355	175
090	270	045	225	315	135	000	180
095	275	050	230	320	140	005	185
100	280	055	235	325	145	010	190
105	285	060	240	330	150	015	195
110	290	065	245	335	155	020	200
115	295	070	250	340	160	025	205
120	300	075	255	345	165	030	210
125	305	080	260	350	170	035	215
130	310	085	265	355	175	040	220
135	315	090	270	000	180	045	225
140	320	095	275	005	185	050	230
145	325	100	280	010	190	055	235
150	330	105	285	015	195	060	240
155	335	110	290	020	200	065	245
160	340	115	295	025	205	070	250
165	345	120	300	030	210	075	255
170	350	125	305	035	215	080	260
175	355	130	310	040	220	085	265

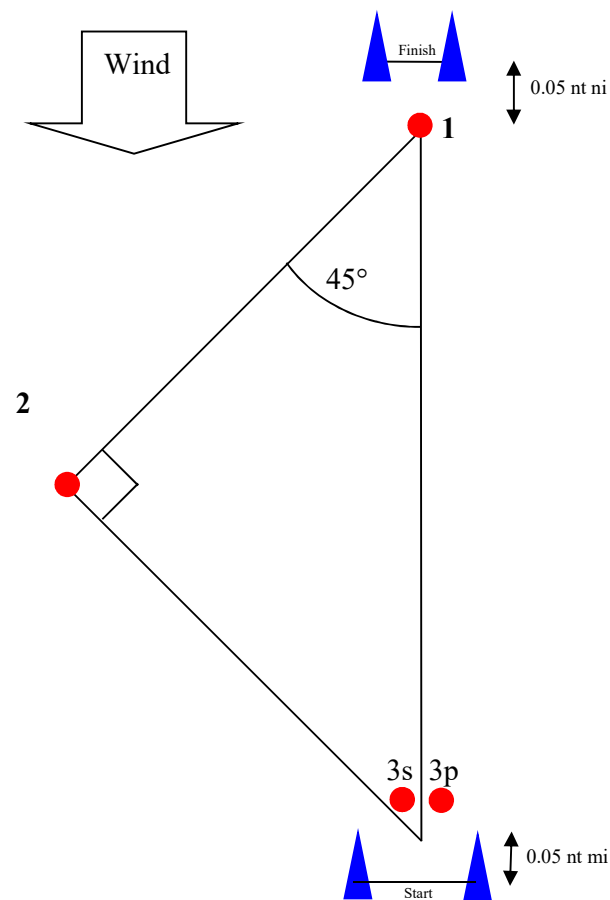
Course Axis	Angles ind degrees						
	3 to 1	1 to 3	3 to 2	2 to 3	1 to 2	2 to 1	Signal to Pin
180	000	135	315	045	225	090	270
185	005	140	320	050	230	095	275
190	010	145	325	055	235	100	280
195	015	150	330	060	240	105	285
200	020	155	335	065	245	110	290
205	025	160	340	070	250	115	295
210	030	165	345	075	255	120	300
215	035	170	350	080	260	125	305
220	040	175	355	085	265	130	310
225	045	180	000	090	270	135	315
230	050	185	005	095	275	140	320
235	055	190	010	100	280	145	325
240	060	195	015	105	285	150	330
245	065	200	020	110	290	155	335
250	070	205	025	115	295	160	340
255	075	210	030	120	300	165	345
260	080	215	035	125	305	170	350
265	085	220	040	130	310	175	355
270	090	225	045	135	315	180	000
275	095	230	050	140	320	185	005
280	100	235	055	145	325	190	010
285	105	240	060	150	330	195	015
290	110	245	065	155	335	200	020
295	115	250	070	160	340	205	025
300	120	255	075	165	345	210	030
305	125	260	080	170	350	215	035
310	130	265	085	175	355	220	040
315	135	270	090	180	000	225	045
320	140	275	095	185	005	230	050
325	145	280	100	190	010	235	055
330	150	285	105	195	015	240	060
335	155	290	110	200	020	245	065
340	160	295	115	205	025	250	070
345	165	300	120	210	030	255	075
350	170	305	125	215	035	260	080
355	175	310	130	220	040	265	085

45°, 90°, 45° Triangular Course

Start/Finish (TL) 0.05 NM downwind of mark 3s/3p or Finish (TW) 0.05 NM upwind of Mark 1

Leg lengths		
3 to 1	3 to 2	1 to 2
1 to 3	2 to 3	2 to 1
0.30	0.21	0.21
0.35	0.25	0.25
0.40	0.28	0.28
0.45	0.32	0.32
0.50	0.35	0.35
0.55	0.39	0.39
0.60	0.42	0.42
0.65	0.46	0.46
0.70	0.49	0.49
0.75	0.53	0.53
0.80	0.57	0.57
0.85	0.60	0.60
0.90	0.64	0.64
0.95	0.67	0.67
1.00	0.71	0.71
1.05	0.74	0.74
1.10	0.78	0.78
1.15	0.81	0.81
1.20	0.85	0.85
1.25	0.88	0.88
1.30	0.92	0.92
1.35	0.95	0.95
1.40	0.99	0.99
1.45	1.03	1.03
1.50	1.06	1.06

Course Distances					
TL2	TL3	TL4	TW2	TW3	TW4
1.42	2.02	2.74	1.12	1.72	2.44
1.65	2.35	3.20	1.30	2.00	2.85
1.86	2.66	3.62	1.46	2.26	3.22
2.09	2.99	4.08	1.64	2.54	3.63
2.30	3.30	4.50	1.80	2.80	4.00
2.53	3.63	4.96	1.98	3.08	4.41
2.74	3.94	5.38	2.14	3.34	4.78
2.97	4.27	5.84	2.32	3.62	5.19
3.18	4.58	6.26	2.48	3.88	5.56
3.41	4.91	6.72	2.66	4.16	5.97
3.64	5.24	7.18	2.84	4.44	6.38
3.85	5.55	7.60	3.00	4.70	6.75
4.08	5.88	8.06	3.18	4.98	7.16
4.29	6.19	8.48	3.34	5.24	7.53
4.52	6.52	8.94	3.52	5.52	7.94
4.73	6.83	9.36	3.68	5.78	8.31
4.96	7.16	9.82	3.86	6.06	8.72
5.17	7.47	10.24	4.02	6.32	9.09
5.40	7.80	10.70	4.20	6.60	9.50
5.61	8.11	11.12	4.36	6.86	9.87
5.84	8.44	11.58	4.54	7.14	10.28
6.05	8.75	12.00	4.70	7.40	10.65
6.28	9.08	12.46	4.88	7.68	11.06
6.51	9.41	12.92	5.06	7.96	11.47
6.72	9.72	13.34	5.22	8.22	11.84



Reference Point for laying the course is the middle of the Mark 3s/3p gate

- TW2** Start – 1 – 2 – 3s – Finish (Upwind)
- TW3** Start – 1 – 2 – 3s – 1 – 3s/3p – Finish (Upwind)
- TW4** Start – 1 – 2 – 3s – 1 – 3s/3p – 1 – 2 – 3s – Finish (Upwind)
- TL2** Start – 1 – 2 – 3s – 1 – Finish (Downwind)
- TL3** Start – 1 – 2 – 3s – 1 – 3s/3p – 1 – Finish (Downwind)
- TL4** Start – 1 – 2 – 3s – 1 – 3s/3p – 1 – 2 – 3s – 1 – Finish (Downwind)

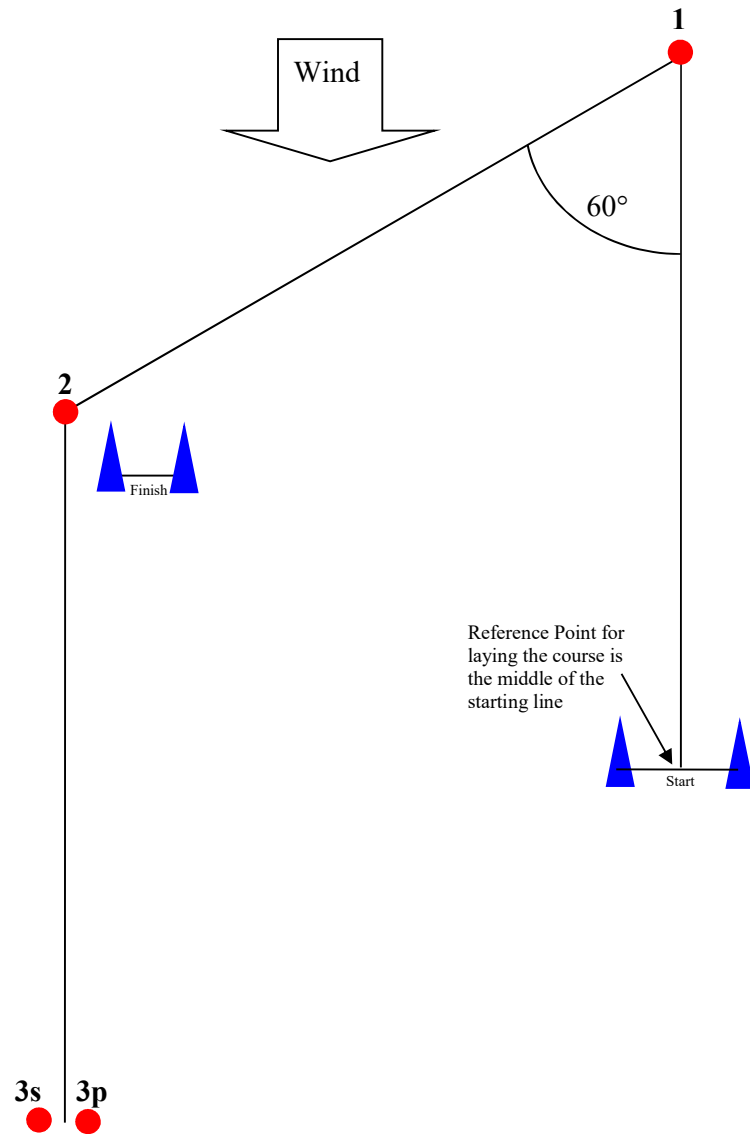
Optimist Course 60°, 120° interior angles - Finish laid 50 m from Mark 2 on the inside of the course.

Course Axis	1 - Reference	2 - Reference	1 - 2	2 - 1	3 - Reference	Reference - 3	Signal - Pin	Pin - Signal
000	180	120	240	060	060	240	270	090
005	185	125	245	065	065	245	275	095
010	190	130	250	070	070	250	280	100
015	195	135	255	075	075	255	285	105
020	200	140	260	080	080	260	290	110
025	205	145	265	085	085	265	295	115
030	210	150	270	090	090	270	300	120
035	215	155	275	095	095	275	305	125
040	220	160	280	100	100	280	310	130
045	225	165	285	105	105	285	315	135
050	230	170	290	110	110	290	320	140
055	235	175	295	115	115	295	325	145
060	240	180	300	120	120	300	330	150
065	245	185	305	125	125	305	335	155
070	250	190	310	130	130	310	340	160
075	255	195	315	135	135	315	345	165
080	260	200	320	140	140	320	350	170
085	265	205	325	145	145	325	355	175
090	270	210	330	150	150	330	000	180
095	275	215	335	155	155	335	005	185
100	280	220	340	160	160	340	010	190
105	285	225	345	165	165	345	015	195
110	290	230	350	170	170	350	020	200
115	295	235	355	175	175	355	025	205
120	300	240	000	180	180	000	030	210
125	305	245	005	185	185	005	035	215
130	310	250	010	190	190	010	040	220
135	315	255	015	195	195	015	045	225
140	320	260	020	200	200	020	050	230
145	325	265	025	205	205	025	055	235
150	330	270	030	210	210	030	060	240
155	335	275	035	215	215	035	065	245
160	340	280	040	220	220	040	070	250
165	345	285	045	225	225	045	075	255
170	350	290	050	230	230	050	080	260
175	355	295	055	235	235	055	085	265

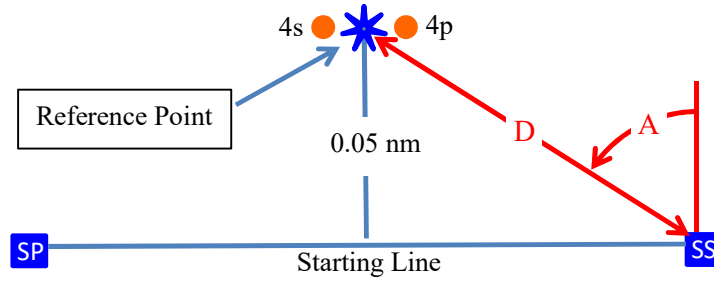
Course Axis	1 - Reference	2 - Reference	1 - 2	2 - 1	3 - Reference	Reference - 3	Signal - Pin	Pin - Signal
180	000	300	060	240	240	060	090	270
185	005	305	065	245	245	065	095	275
190	010	310	070	250	250	070	100	280
195	015	315	075	255	255	075	105	285
200	020	320	080	260	260	080	110	290
205	025	325	085	265	265	085	115	295
210	030	330	090	270	270	090	120	300
215	035	335	095	275	275	095	125	305
220	040	340	100	280	280	100	130	310
225	045	345	105	285	285	105	135	315
230	050	350	110	290	290	110	140	320
235	055	355	115	295	295	115	145	325
240	060	0	120	300	300	120	150	330
245	065	5	125	305	305	125	155	335
250	070	10	130	310	310	130	160	340
255	075	15	135	315	315	135	165	345
260	080	20	140	320	320	140	170	350
265	085	25	145	325	325	145	175	355
270	090	30	150	330	330	150	180	000
275	095	35	155	335	335	155	185	005
280	100	40	160	340	340	160	190	010
285	105	45	165	345	345	165	195	015
290	110	50	170	350	350	170	200	020
295	115	55	175	355	355	175	205	025
300	120	60	180	000	000	180	210	030
305	125	65	185	005	005	185	215	035
310	130	70	190	010	010	190	220	040
315	135	75	195	015	015	195	225	045
320	140	80	200	020	020	200	230	050
325	145	85	205	025	025	205	235	055
330	150	90	210	030	030	210	240	060
335	155	95	215	035	035	215	245	065
340	160	100	220	040	040	220	250	070
345	165	105	225	045	045	225	255	075
350	170	110	230	050	050	230	260	080
355	175	115	235	055	055	235	265	085

Optimist Course 60°, 120° Interior Angles. Equal Leg lengths

Leg Lengths					Course Distance
Reference - 1	Reference - 2	Reference - 3	1 - 2 2 - 3	3 - Finish	
0.2	0.2	0.2	0.2	0.17	0.77
0.25	0.25	0.25	0.25	0.22	0.97
0.3	0.3	0.3	0.3	0.27	1.17
0.35	0.35	0.35	0.35	0.32	1.37
0.4	0.4	0.4	0.4	0.37	1.57
0.45	0.45	0.45	0.45	0.42	1.77
0.5	0.5	0.5	0.5	0.47	1.97
0.55	0.55	0.55	0.55	0.52	2.17
0.6	0.6	0.6	0.6	0.57	2.37
0.65	0.65	0.65	0.65	0.62	2.57
0.7	0.7	0.7	0.7	0.67	2.77
0.75	0.75	0.75	0.75	0.72	2.97
0.8	0.8	0.8	0.8	0.77	3.17
0.85	0.85	0.85	0.85	0.82	3.37
0.9	0.9	0.9	0.9	0.87	3.57
0.95	0.95	0.95	0.95	0.92	3.77
1	1	1	1	0.97	3.97
Course IOD					
Start - 1 - 2 - 3s/3p - Finish					



2.5 Determining the Reference Position



Starting Line		Length (D) Signal Boat to Reference	Angle(A) to subtract from
Length	Length (Nt mi)		
80	0.04	0.05	23
90	0.05	0.06	26
100	0.05	0.06	28
110	0.06	0.06	31
120	0.06	0.06	33
130	0.07	0.06	35
140	0.08	0.06	37
150	0.08	0.06	39
160	0.09	0.07	41
170	0.09	0.07	43
180	0.1	0.07	44
190	0.1	0.07	46
200	0.11	0.07	47
210	0.11	0.08	49
220	0.12	0.08	50
230	0.12	0.08	51
240	0.13	0.08	52
250	0.13	0.08	53
260	0.14	0.09	55
270	0.15	0.09	56
280	0.15	0.09	57
290	0.16	0.09	57
300	0.16	0.1	58
310	0.17	0.1	59
320	0.17	0.1	60
330	0.18	0.1	61
340	0.18	0.1	61
350	0.19	0.11	62
360	0.19	0.11	63
370	0.2	0.11	63
380	0.21	0.11	64
390	0.21	0.12	65
400	0.22	0.12	65
410	0.22	0.12	66
420	0.23	0.12	66
430	0.23	0.13	67
440	0.24	0.13	67
450	0.24	0.13	68
460	0.25	0.13	68
470	0.25	0.14	68
480	0.26	0.14	69
490	0.26	0.14	69
500	0.27	0.14	70