Mark Laying Duties and Procedures

Note: While this manual was designed for use during the U.S. Youth Sailing Championships and focuses on the Laser, Club 420/ International 420, Radial, International 420 and 29er, much of the material is applicable to other events.

(Based on Olympic Instructions Version 4 of 29 Sep 08.
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Mark Boat Duties and Procedures

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1 Summary of Procedures (12 and 16 apply to trapezoidal courses)

1. Mark boats should be crewed by three people, at least one of whom must be proficient in the use of GPS.
2. GPS shall be set on nautical miles (decimals), magnetic bearings, and WGS 84 Map datum. (See page 21).
3. All times will be derived from GPS [UTC] time (e.g. Casio G-Shock Atomic watch or equivalent).
4. Laser range finders will be used to assist with starting line lengths. If possible, they should be used for setting the distance between gate marks, for the offset mark on W/L courses and for finishing line length.
5. The middle of the gate 4S/4P is the reference point for laying the course unless the Signal Boat advises differently because of a mark change.
6. The reference point when changing the position of a mark for a course change will be the other mark of that leg (i.e. mark 1 for mark 4S/4P and vice versa and mark 2 for mark 3S/3P and vice versa).
7. The race committee boats of each circle will leave the host club together and go to the course area together.
8. Course changes will be made to reconfigure the course to a new wind or to adjust the length to meet the target time. This will be decided by the PRO for each circle and communicated to the support boats.
9. Original marks will be TBD. Change marks will be TBD.
10. A reference point and an anticipated course axis and length will be determined by the PRO for each course by at least start minus 45 minutes. A final reference point will be broadcast by start minus 15 minutes.
11. Mark Boats One and Two will be on station in approx. mark position at start minus 60 minutes and have taken first wind reading by this time. Support boats will remain drifting at this time.
12. From start minus 60 to start minus 15, **Finish** is in the approx. location of Mark 3 gate. She takes wind readings to ensure a consistent breeze.
13. **Start Pin** takes current readings from the **Signal Boat** or another fixed mark as a reference, until positioned at end of start line.
14. Current readings will be made every 15 minutes once marks are laid (keeping out of the way of the racers).
15. The final course axis and length will be determined by start minus 10 minutes. At this time Start Pin will be anchored. Mark 1 will be laid by the warning signal. For trap course, Mark 2 and Mark 3 gate are laid soon after. Mark 4 gate is laid as soon as possible after the start of the second start. Trap course Finish and Finish Pin should be laid before the racing boats round Mark 2 for the last time. Marshall boat patrols coach area.
16. The 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 boat as the course axis, then the PRO should be notified, and he may ask for a change of direction to be signalled at Mark 2.
17. Once marks are laid the Latitude and Longitude of each mark will be recorded and radioed to the **Signal Boat.** Mark boats will also record this information so that range and bearing from any mark may be used for course changes.
18. 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 Boat**.
19. Mark roundings will be recorded by mark boats and the times of first and last of each fleet radioed to the **Signal Boat** as each happens.
20. When signalling a change at Mark 1 or Mark 2, a mark boat will be stationed 10 fleet boat lengths (~ 150 ft) away and in a direction which is at right angles to the direction of the course from the last mark and on the starboard side of the boats as they round the mark. Mark boats shall anchor only when signalling a course change or signalling a mark missing.
21. At a gate mark, the boat signalling a change will be 5 boat lengths downwind between the gate marks.
22. All mark boats may be required to inform racing boats that they were identified as OCS or BFD, drawing attention by sounding 1 blast on a horn and displaying the boat's recall number.
23. Marks shall be carried on mark boats in a deflated state. Change marks shall only be inflated just prior to use and original marks shall be removed and deflated as soon as practicable.
24. Marks shall not be towed from the club to a race course in LI Sound.

2 Mark Boats, Call Signs and Responsibilities

There will be a signal boat, two mark boats, one start pin boat, a finish boat for the trapezoid course, a signal boat, a marshal boat, and safety boats.

Mark boats will be assigned as follows:

Trapezoid Courses

MARK BOATS and Call Sign	RESPONSIBILITY
Mark Boat One	mark one, mark two, change mark
Mark Boat Two	mark 4S and 4P, set finish pin, change mark
Finish Boat	mark 3S and 3P, take finishes
Start Pin	serve as port end start pin, help sight start line, other duties as assigned
Signal Boat	starboard end of starting line

Windward Leeward Courses

MARK BOATS and Call Sign	RESPONSIBILITY
Mark Boat One	mark one, mark 1A, change mark
Mark Boat Two	marks 4S and 4P, change marks
Start Pin	serve as port end start pin, help sight start line, set finish pin, other duties as assigned
Signal Boat	starboard end of starting line, starboard end of finishing line

For All Courses

Marshal One	Overall control of safety, support boat movement and spectator craft.
Rescue One, Two ….	These boats 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 **Marshal One**. In really foul weather all mark laying boats would assist with safety and should be trained in facilitating a rescue of both sailors and equipment.

3 Daily Schedule Example – Actual times may vary

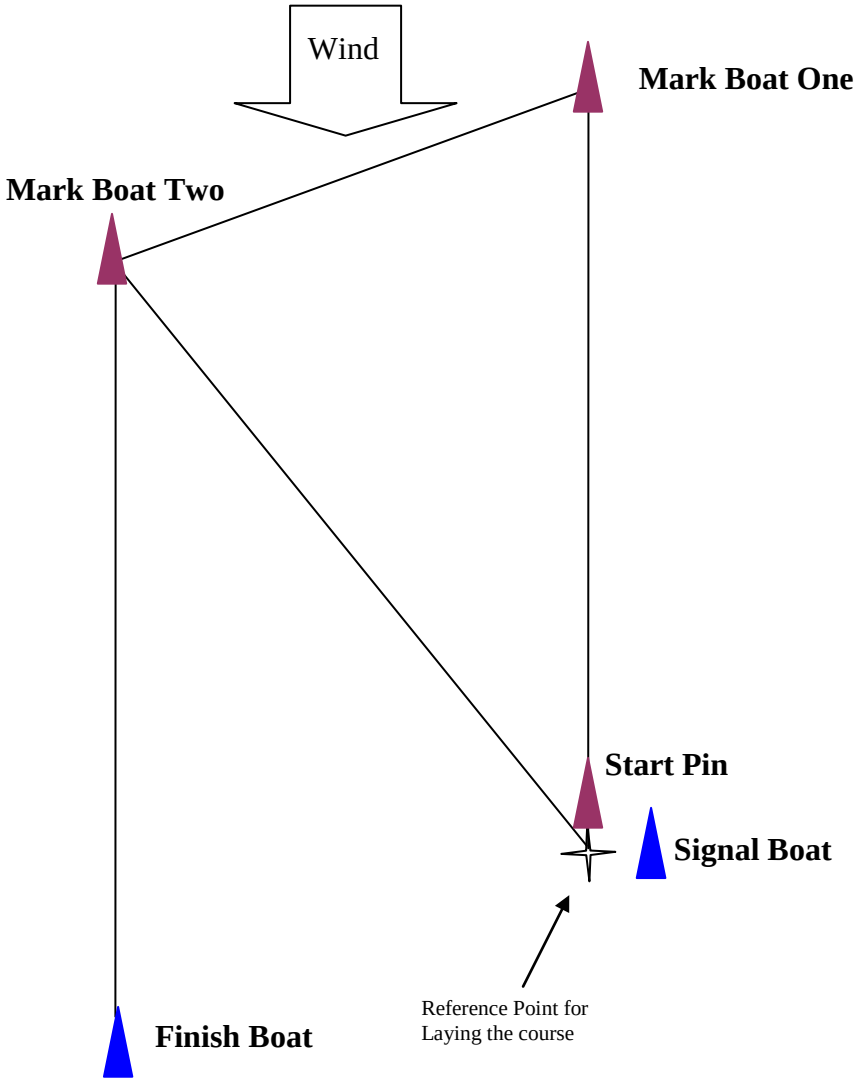
Day One Hour	Other Day Hour	Time in relation to first warning	Action
9:00	8:00	-3.00	Meeting of PROs & DROs with Event Chair, Host Club Chair and Chief Judge.
9:30	8:15	-2.45	PROs and Deputies meet with RC team to explain the day's procedure.
8:30	8:30	-4:30/2:30	Competitors' Meeting
10:00	8:45	- 3:00/2:15	Check of equipment on board and that all systems function and are stowed correctly. Pick up lunches, water, radio, paper work. First rescue boat launched and available to escort sailors to the race area when "Delta" is signaled.
11:15	9:15	-1:45	Race committee boats leave the base area together for the race area. Radio check completed. (Captain Harbor circle(s) may be able to leave a bit later).
12:00	10:00	-1:00	Signal boat on station anchored in the anticipated start position.
12:15	10:15	-0:45	Reference position determined by Race Officer and radioed to all mark boats with anticipated course axis and length (using actual wind observed by committee boat on the way to the course area and from weather forecasts).
12:20	10:20	-0:40	All mark boats in approximate positions starting to take wind readings.
12:25	10:25	-0:35	Initial wind speed and bearing radioed to **Signal Boat**. Wind now monitored at least every 5 minutes - any significant change reported to **Signal Boat**. This will be continued for the duration of racing. Use GPS to estimate current flow. Complete time check with course timer (**Signal Boat**).
12:30	10:30	-0:30	Wind speed and direction updated to **Signal Boat**.
12:50	10:50	-0:15	●Finish (trap course) moves out of the course area to approximate position. Start Pin moves to anchor. Final adjustments of Starting line direction made by the preparatory signal. The Signal boat determines the final reference position and transmits it to all boats. Marshall boat patrols coach boat zone. ●Race Officer on W/L courses confirms course axis and leg length. Mark boats on W/L course(s) proceed to lay course per method outlined in Article 25 herein.
12:55	10:55	-0:05	Trapezoid Course axis and length confirmed by Race Officer. Trapezoid Course Mark boats move into final position to lay marks.
13:00	11:00	-0:00	First Warning Signal. Last adjustments to starting line.
13:01	11:01	+0.01	First Preparatory Signal. Mark 1 laid by this time.
13:05	11:05	+0:05	Starting signal of first class to start. Mark 2 laid by this time (trapezoid course).
13:15	11:15	+0:15 (Approx)	Mark 3 Gates laid (trapezoid course)..
		During the race	Mark boats 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 Boat** and any movement of the mark. Measure tidal flow every 15 minutes when possible (i.e no racing boats in the vicinity). Record every boat (sail number and time) as they round the mark every time. Report to the **Signal Boat** 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 the Signal boat. Return radio for charging.
		Race end + 60 minutes	Team de-briefing.

4 Mark boat positions in period Warning minus 40 to start minus 15 minutes (trapezoid).

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.

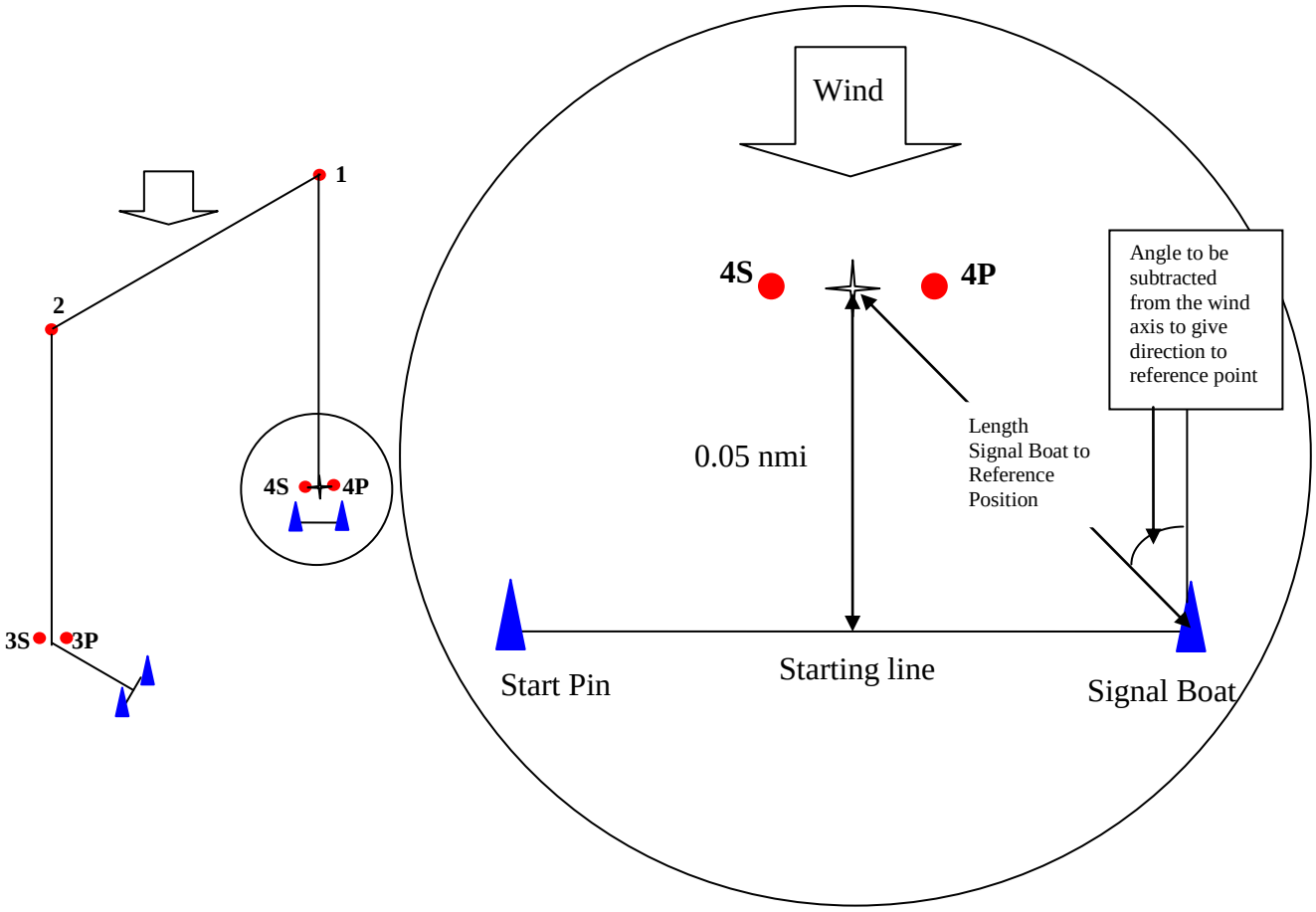
The signal boat anchors in its anticipated position. **All other boats remain drifting.** Every boat monitors wind speed and direction every 5 minutes and monitors drift using the features of the GPS.
Once a mark is laid tidal flow is monitored using a tide stick.

Signal Boat at starboard end of the starting line.
Start Pin on the mark laying reference position.
Mark Boat One at the expected position of mark 1
Mark Boat Two at the expected position of mark 2
Finish Boat at the expected position of mark 3S/3P



5 ***Laying the Start Pin***

1. Receive GPS position of the signal boat from the signal boat or ping the signal boat. The starting line length will be given by the RO.
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. 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.
4. Take a compass heading to the signal boat from this spot and continue to weather.
5. Go to weather to gain enough distance to: (See page 34):
   a. get a good set, and the proper rode/scope minimum of four times the depth of water
   b. add enough rode so you can move up 5 degrees if requested (10 yds for every 100 yds of starting line length)
   c. have enough rode to move back 5 degrees
6. After anchoring move back to compass position.
7. Check location using a compass.
8. Continue to monitor position with a compass.

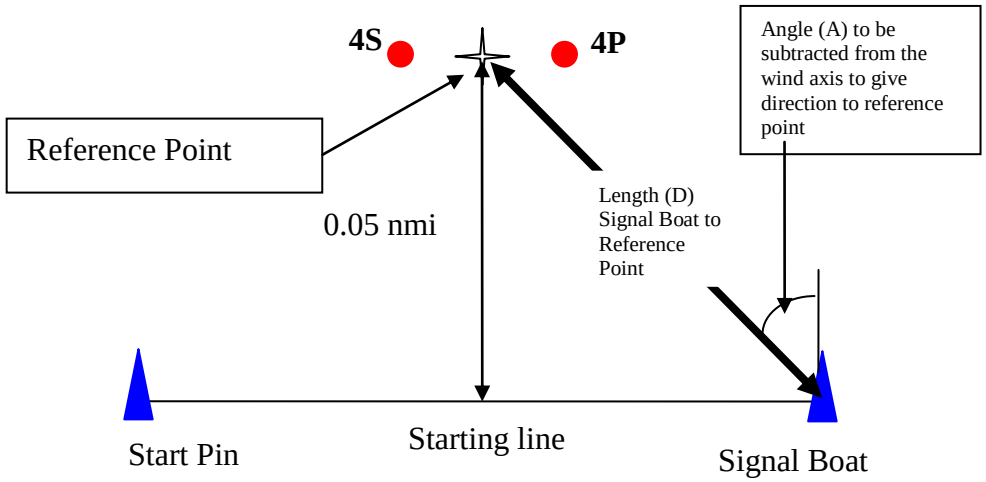


6 Start line Lengths

Class	Boat Length (feet)	Multiplying factor	Number of Boats	Start Line Length (yards)	Start Line Length Nautical Miles
Laser/ Laser Radial	14	1.25	20	117	0.06
Club 420/ International 420	14	1.25	30	175	0.09
29er	14.5	2.0	10	97	0.05

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 (some longer and other shorter) to leave the starting line alone rather than delay starts to reset the line at the optimum length.

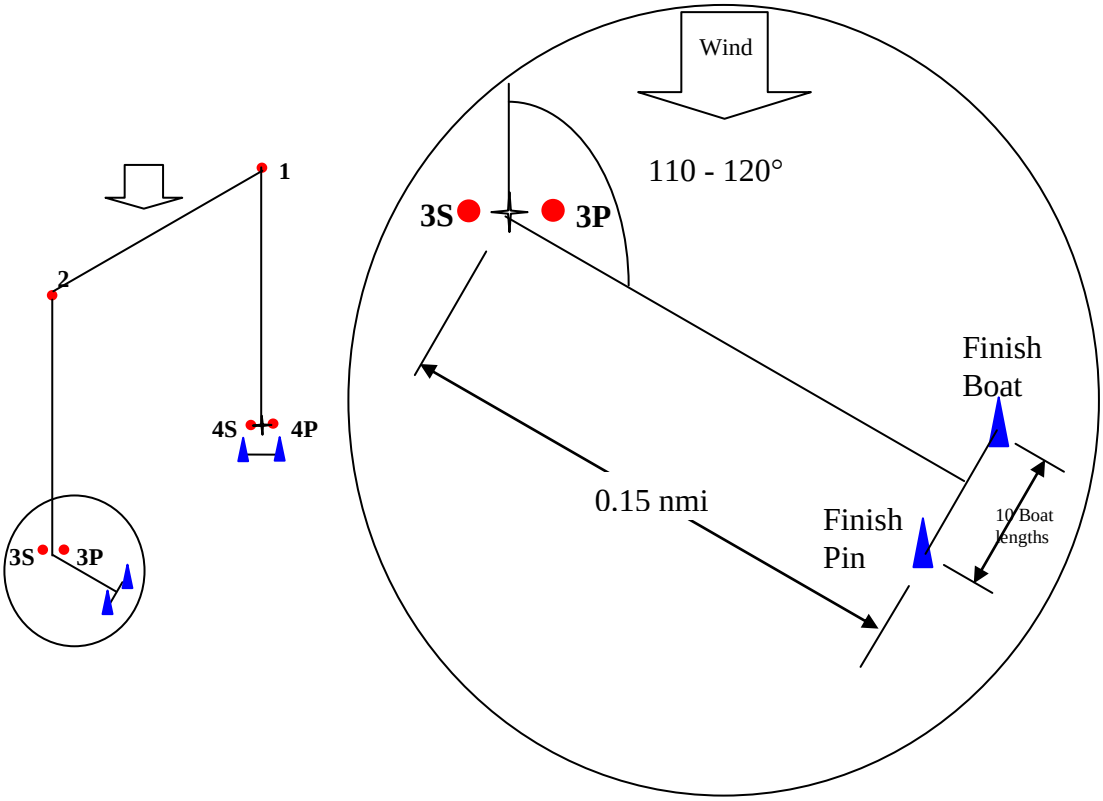
7 Determining the Reference Position (see see your GPS instructions for projecting this waypoint from the signal boat location)



Starting Line		Length (D) Signal Boat to Reference Point (nmi)	Angle(A) to subtract from Course Axis (degrees)
Length (yds)	Length (nmi)		
80	0.04	0.05	23
100	0.05	0.06	27
120	0.06	0.06	32
140	0.07	0.06	35
160	0.08	0.06	38
180	0.09	0.07	42
200	0.10	0.07	45
220	0.11	0.07	48
240	0.12	0.08	50
260	0.13	0.08	52

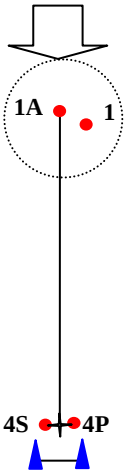
8 Laying the Finishing Line (Trapezoid Course)

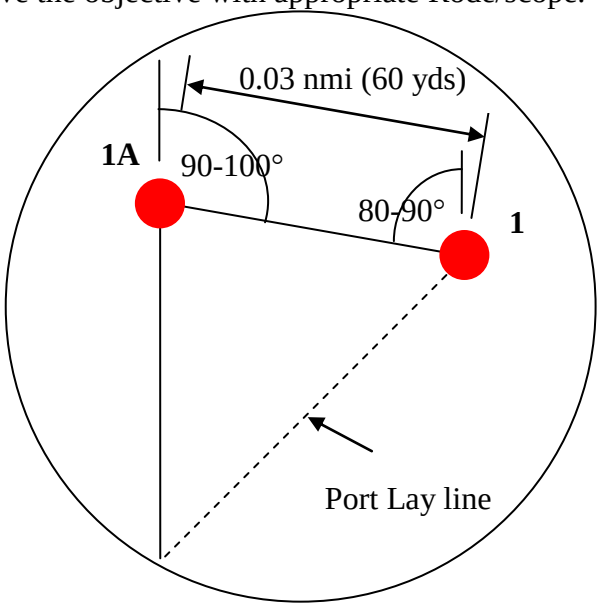
Use the same procedures as the start pin except the distance is 10 boat lengths (for most dinghy fleets 50 yds is good)



9 Laying Mark 1 with an Offset mark (Windward / Leeward Course

1. Lay the offset mark first using the range and bearing from the Reference Point.
2. Ping the offset mark and proceed to starboard at plus 90° to the course axis for approx 60 yds using a rangefinder (if available) to help determine this distance
3. Read back the reciprocal heading.
4. If the wind has been showing a tendency to veer right set the mark at course axis plus 100°
5. If the wind has been showing a tendency to veer left set the mark at course axis plus 90°
6. To anchor, move the mark boat to weather to achieve the objective with appropriate Rode/scope.



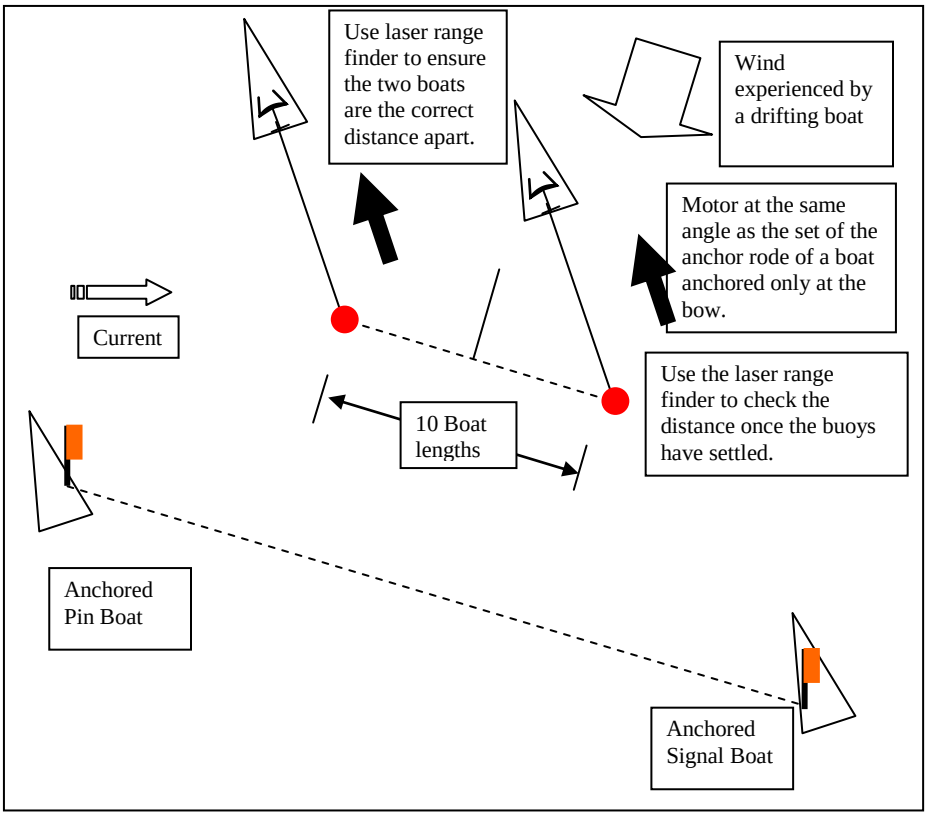


10 Distance between Gate Marks

Class	Boat Length (feet)	Multiplying Factor	Distance (feet)
Laser	14	10	140
Laser Radial	14	10	140
C420/I420	14	10	140
29er	14.5	10	145

11 Laying the Gate Marks - Two boats

1. Both boats 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.
2. The boats should cross the starting line together to keep the bearing between the boats as wind axis plus or minus ninety degrees. The distance between the boats is estimated to be the correct distance between the gate marks
3. On direction of the RO, drop both anchors simultaneously.
4. When there is significant current the boats should motor in a direction that the anchor rode of the marks will be when finally anchored – watch the way in which the signal boat is laying.
5. An imaginary line between the two marks should be at right angles to the wind direction.
6. Adjust as required:
   (i) by dragging the windward one of the two marks downwind.
   (ii) by adding extra warp to the windward one of the two marks.



12 Laying the Gate Marks - One boat

MINOR TO NO CURRENT

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).

2 Look up the course to check that this is downwind of mark 2 (or mark 1) and adjust if it is not.

3 Motor to port (looking up the course) a couple of boat 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).

4 Check that the mark is sitting upright and that the anchor is holding.

5 Return downwind of this mark and this time trail the mark and the warp with just the anchor aboard the mark boat.

6 Motoring slowly to weather, pass mark 3S on your port side an estimated distance of around 10 boat lengths (12 boat lengths if high wind).

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 Continue motoring until the mark you are towing gets to about 10 ft downwind of the tide stick, drop the anchor.

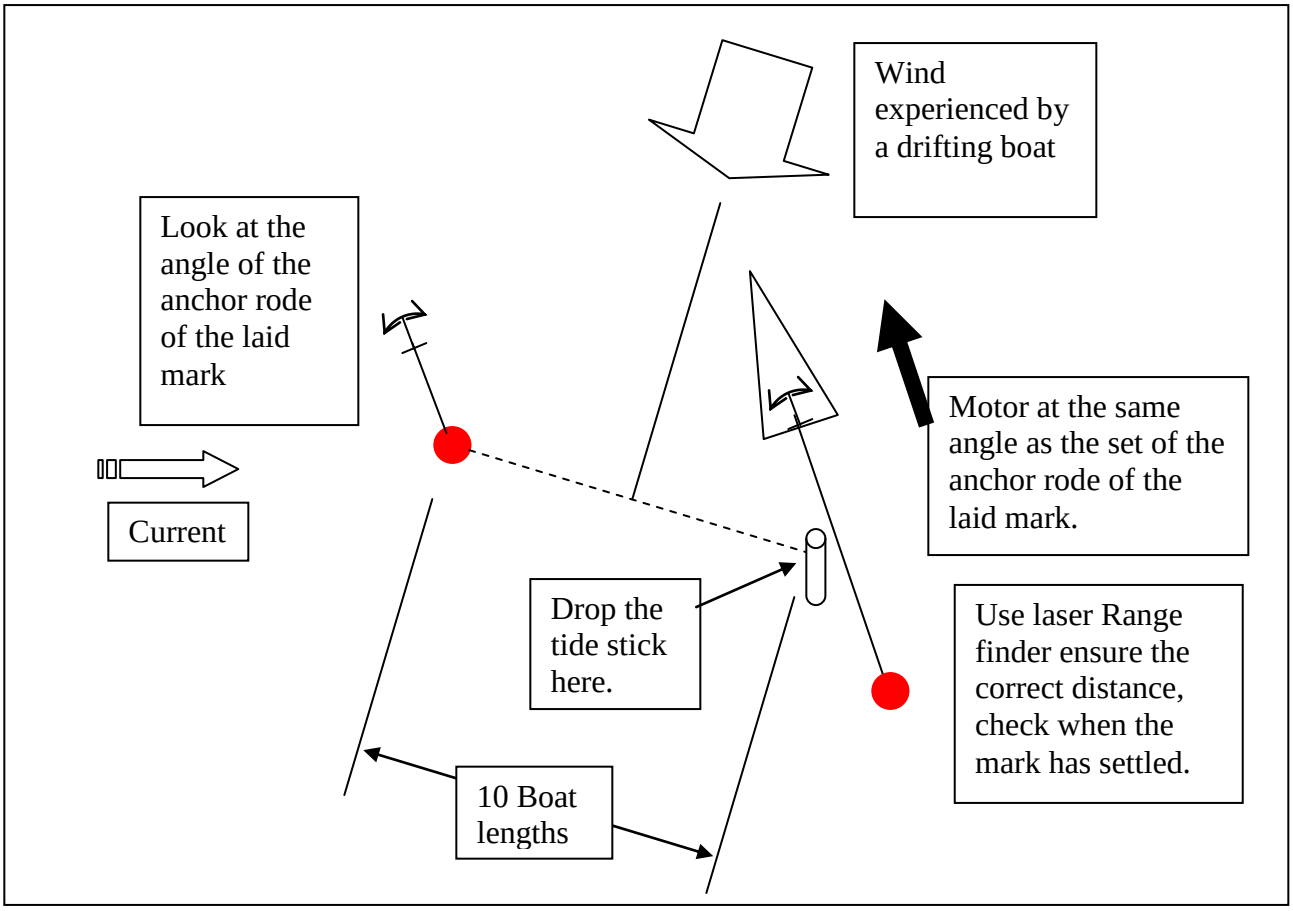
9 The marks should be at right angles, relative to the wind.

10 For small adjustments drag the windward mark downwind.

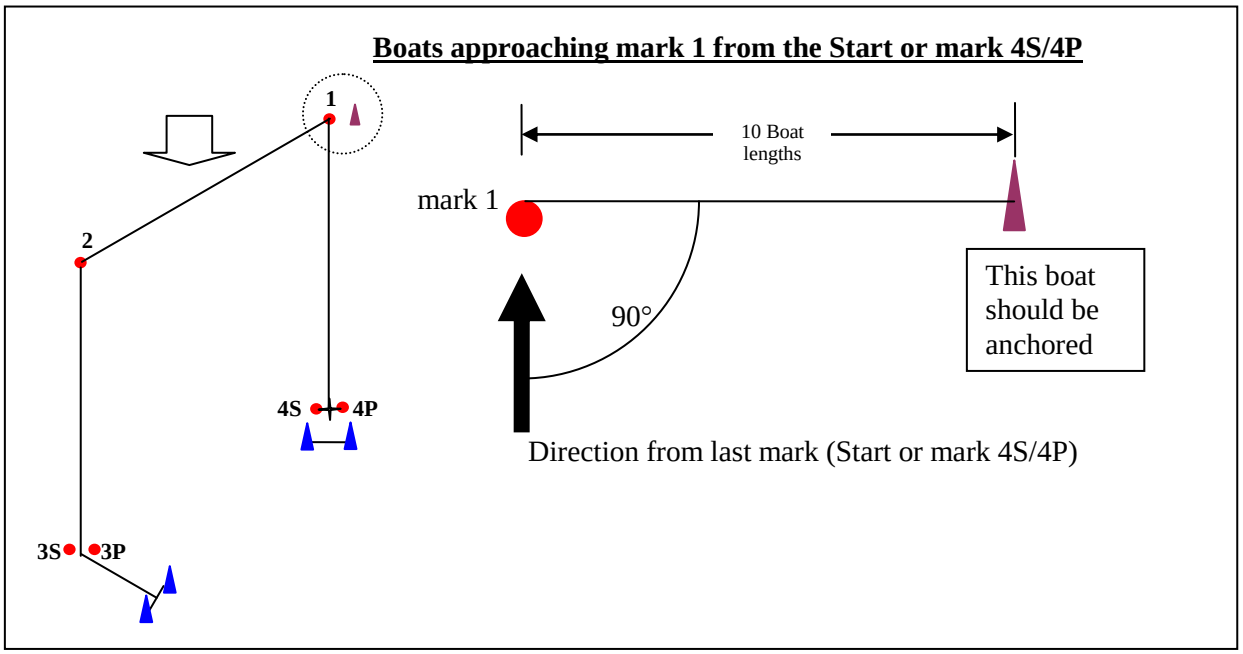
11 For large adjustments pick up one mark and relay.

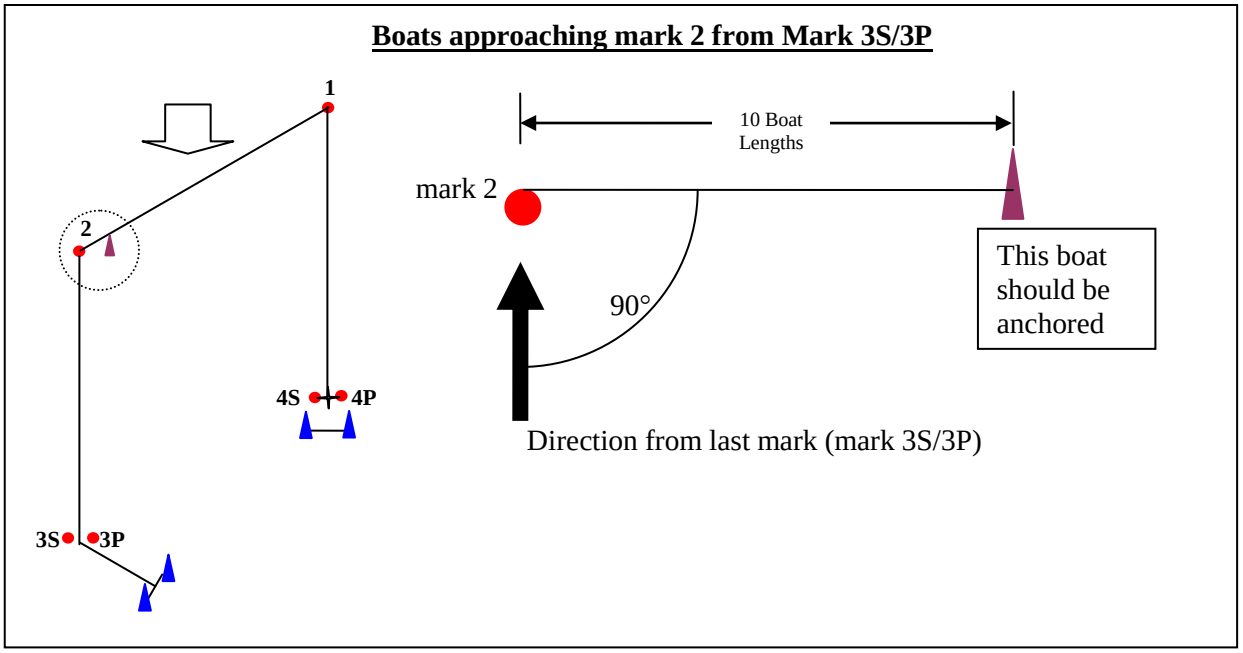
STRONG CURRENT

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.

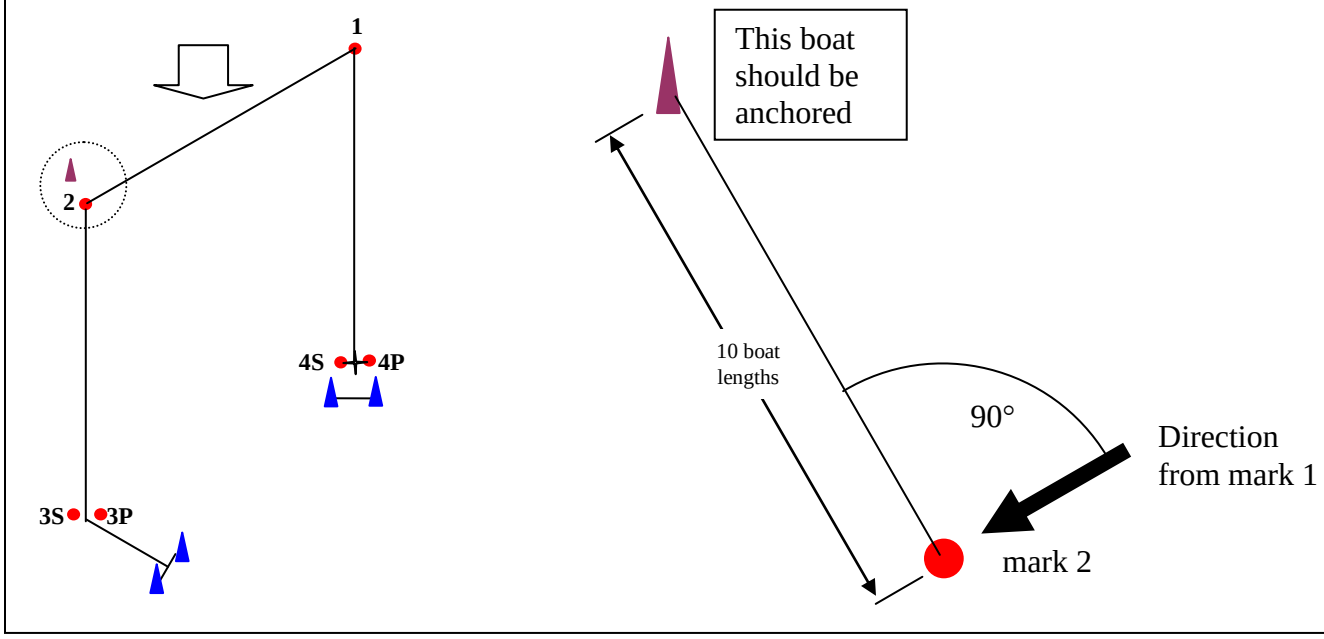


13 ***Positions of Course Change Signal boats.***

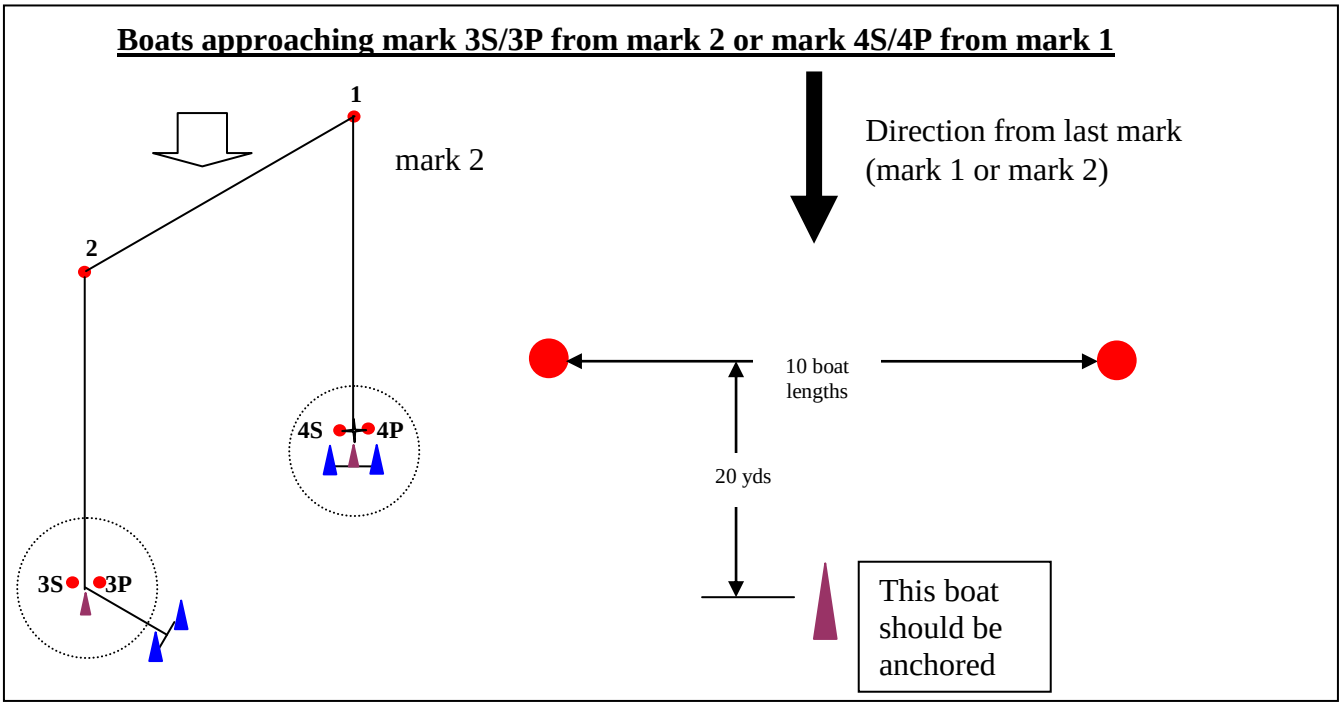




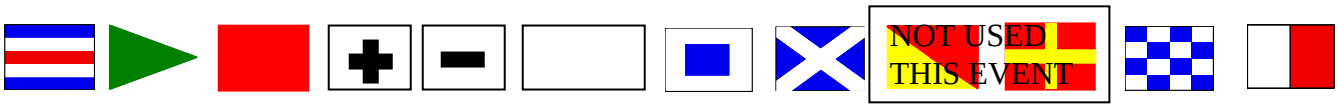
Boats approaching mark 2 from mark 1

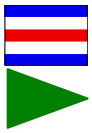
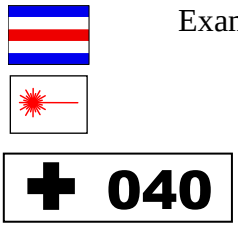
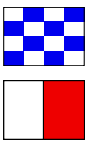


Boats approaching mark 3S/3P from mark 2 or mark 4S/4P from mark 1

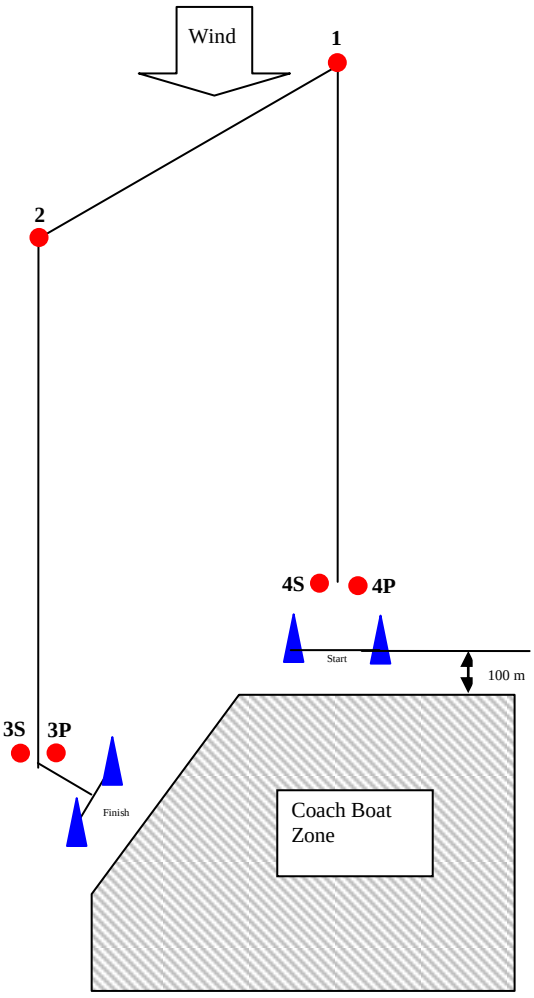


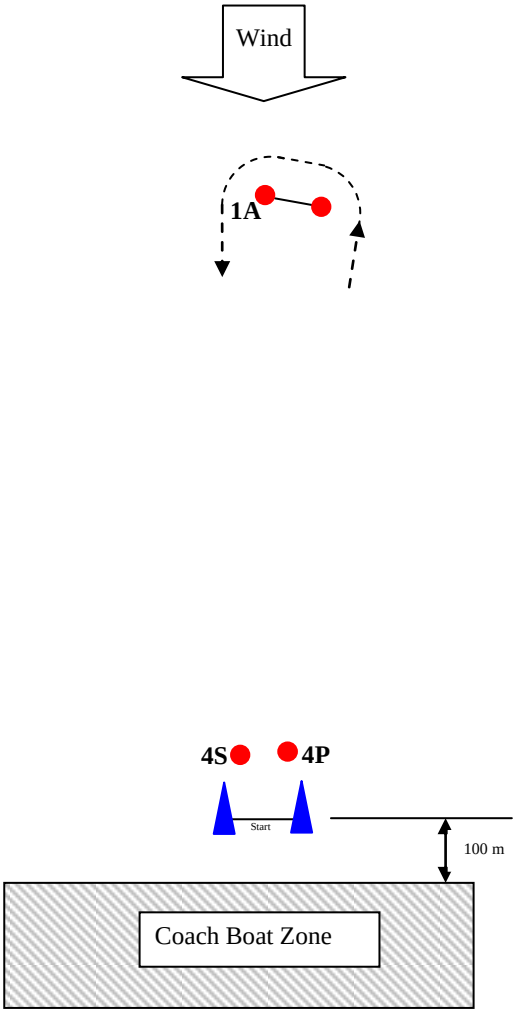
14 *Visual Signals displayed by Mark Boats*



Change of Course - Flag C		
	(- - - - -) Repetitive sounds while the signal is displayed	The position of the next *mark* has been changed. This signal is displayed with a red or green shape or flag for sailboards 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 sailboard courses, means the next mark is to starboard of the original. **[We will use red and green flags, and not compass bearings]**
 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 lengthened. Use 000 for due north.
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 *mark.*
Changes to Rule 42 – Flags O and R (Not Used for this Regatta)		
 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 *abandoned*. Return to the starting area.
	□•••	All races are *abandoned*. Further signals ashore.

15 Coach boat Zones





16 Measuring the Wind

In a drifting boat:

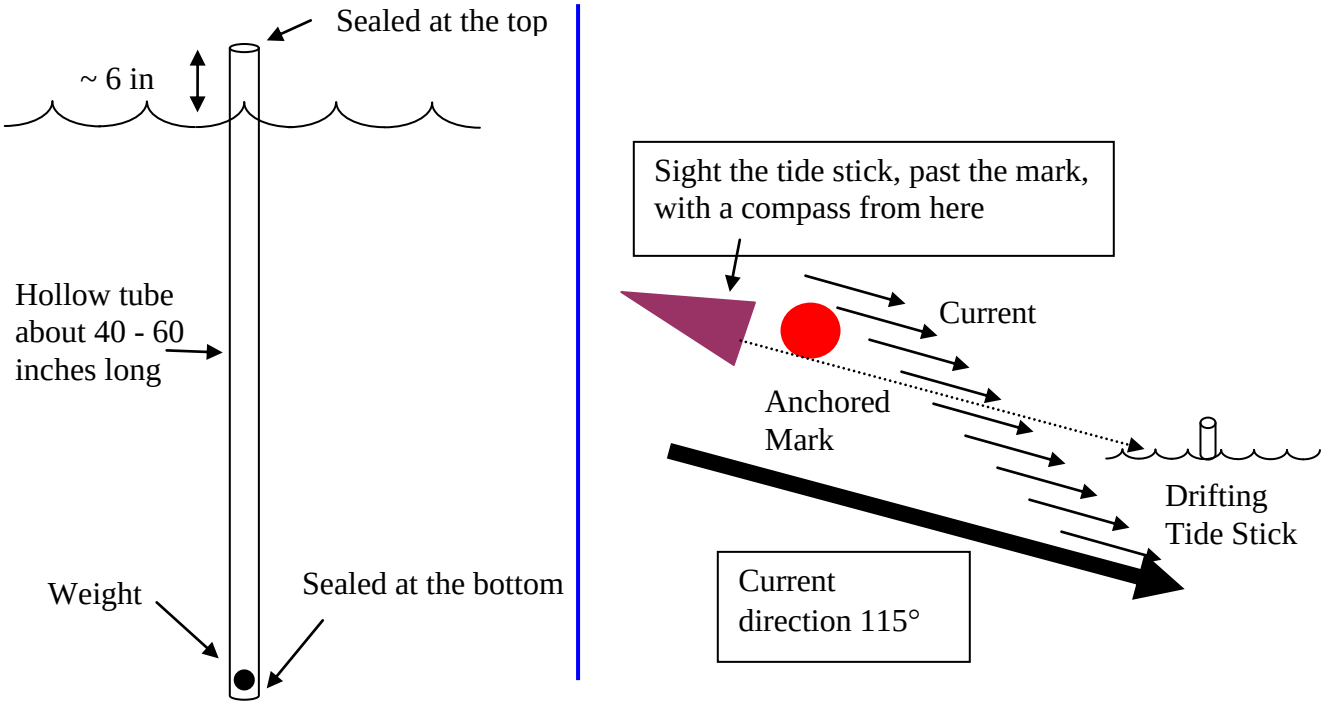
1. At start minus one hour the wind reader observes the wind speed and direction.
2. The recorder writes the actual compass direction of the wind direction found at that time on the sheet (see section 24 Wind Graph paper) at the center/top of the graph and on each side of this figure he/she adds or subtracts 5 degree increments.
3. It is best to have a wind reader and a recorder working together.
4. For the first half hour record the time, wind direction and speed. Mark on the graphs with a dot the speed and direction.
5. After the first half hour, connect the dots, which will give you a graph. Draw a colored vertical line down the center of all the direction dots which will give you an average wind direction for the first half hour.
6. At 55 minutes with a colored marker draw another vertical line down the center of the dots for the second half hour.
7. Repeat every half hour.

17 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 6 inches above the water.

A simpler, yet effective, device can be made using a piece of ¾ - 1 inch PVC pipe 10-12 inches long, and capped at each end. Wrap stripes of colored PVC tape around the pipe and attach a retrieval loop, which can be made with two cable "zip ties." This device will float on the surface of the water. It should be obvious that the stick is being put overboard intentionally, and is not trash.



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.
Use a laser range finder to find, or estimate, the distance travelled over the time taken and use the formula below to calculate the speed of the current.

$$\text{Speed in Knots} = \frac{\text{Distance in Feet}}{\text{Time in Minutes x 100}}$$

Examples

(i) A stick is estimated to have moved 40 ft. (2 boat lengths) in 1 minute.

Speed in Knots = 40 ÷ 100
= 0.4 knot

(ii) A stick moved 450 ft in 1 minute and 40 seconds. (Use range finder to measure the distance)

Speed in Knots = 450 ÷ (1.67 x 100) = 450 ÷ 167
= 2.7 knots

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

18 Using the GPS (based on Garmin 76)

Setup

General

- Mode — Normal
- WAAS — Disabled
- Backlight Time out — 15 Seconds
- Beeper — Key and Message
- Language — English

Time

- Time Format — 24 hour
- Time Zone — Other UTC offset +13:00
- Daylight Saving Time
- Current Date
- Current Time

Location

- Location format — hddd°mm.mmm'
- Map Datum — WGS 84
- North Reference — Magnetic
- Magnetic Variation

Alarms — all off

Interface

- Serial Data Format — Garmin

Garmin GPSMap76 screens

- GPS Information Page — Location & time
- Map Page
- Pointer Page
- Highway Page
- Active Route Page

Data Fields

- Menu – setup page layout Medium (1 Rows)
  - Change data fields
  - Highlight and enter
  - Top left — BEARING
  - Top right — DISTANCE TO NEXT

Creating Waypoints

- On GPS info page
- Press and hold ENTER
- This gives Mark Waypoint page
- It is the current position with a numeric label. Label and position can be changed using the ROCKER key.
-

Waypoints

- Select the waypoint
- MENU, MENU (gives main menu)
- Scroll to **Points**, then **waypoints**
- Press ENTER and Scroll to your waypoint name / number.
- Press ENTER rocker to GO TO – ENTER- PAGE to Pointer or Highway

19 Radio Procedures (VHF Channels will be announced at RC morning meeting)

Call signs.

The call sign for each mark boat relates to the mark assignment, e.g.
Mark Boat One is "Mark Boat One"
Mark Boat Two is "Mark Boat Two"
The **Start Pin** boat call sign is "Start Pin".
Signal Boat is "Signal Boat"
Finish Boat is "Finish Boat"

Procedure

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

Wait for acknowledgement prior to sending your message. If none received, repeat the call

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 Boat One Out"

Always check your radio to see that it 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
if your battery is dead
if you are on the correct channel.
if the squelch is fully on

Example
Signal Boat, **Signal Boat** this is **Mark Boat One**
Mark Boat One, this is Signal Boat go ahead
Signal Boat this is **Mark Boat One**. The wind direction is steady at 340 degrees and 5 knots. We have 0.4 knots of current from 270 degrees. **Mark Boat One** out.
Mark Boat One, this is **Signal Boat**: All copied. Thank you. **Signal Boat** Clear.

20 Record of GPS Positions

2009 US Youth Championship Date:_____ Recorder: _____

	Time	Latitude	Longitude		Comment
Reference Position					
Signal Boat					
Start Pin					
Mark 1					
Mark 2					
Finish Boat					
Reference Position					
Signal Boat					
Start Pin					
Mark 1					
Mark 2					
Finish Boat					
Reference Position					
Signal Boat					
Start Pin					
Mark 1					
Mark 2					
Finish Boat					
Reference Position					
Signal Boat					
Start Pin					
Mark 1					
Mark 2					
Finish Boat					

*21 **Wind Graph Paper***

Event _2009 US Youth Championship_____

Recorders Name _____ Position _____ Date _____

Current		
Time	Speed	Direction

Time	Wind Speed (Knots)										
			5			10			15			20			25	

Wind Direction													
__	__	__	__	__	__	__							

	Average Direction	Average Velocity	Maximum velocity	Minimum Velocity
First half hour				
Second half hour				
Third half hour				
Fourth half hour				

22 MARK ROUNDING SHEET

Please record the times of first and last boat in each class.

Please record all boats rounding your mark in sequential order. Record as many times as possible. Report to RO when first and last of each leg round your mark **as it happens**.

2009 US YOUTH CHAMPIONSHIP MARK ROUNDING SHEET														
Date:		Recorder:					Lat:				Long:			
	RACE___	MARK_____				RACE___	MARK_____				RACE___	MARK_____		
	TIME	SAIL #	FLAG			TIME	SAIL #	FLAG			TIME	SAIL #	FLAG	
1					1					1				
2					2					2				
3					3					3				
4					4					4				
5					5					5				
6					6					6				
7					7					7				
8					8					8				
9					9					9				
10					10					10				
11					11					11				
12					12					12				
13					13					13				
14					14					14				
15					15					15				
16					16					16				
17					17					17				
18					18					18				
19					19					19				
20					20					20				
21					21					21				
22					22					22				
23					23					23				
24					24					24				
25					25					25				
26					26					26				
27					27					27				
28					28					28				
29					29					29				
30					30					30				

23 Wind Speed Recording Sheet for the Signal Boat

Time	Mark 1		Mark 2		Finish		Start Pin		Signal Boat	
	Speed	Direction	Speed	Direction	Speed	Direction	Speed	Direction	Speed	Direction

24 Trapezoid Course 60°, 120° interior angles

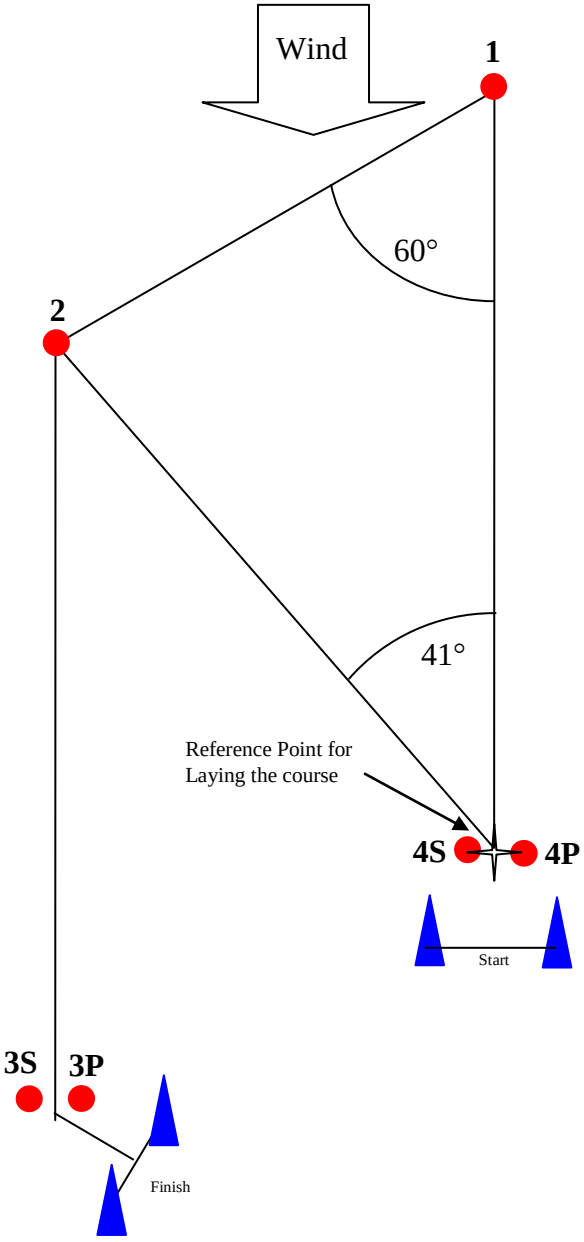
Course Axis	*Trapezoid Course 60, 120 interior angles*								
4 - 1	1 - 4			4 - 3	3 - 4	Signal	Pin -	3 -	Finish
3 - 2	2 - 3	4 - 2	2 - 4	1 - 2	2 - 1	- Pin	Signal	Finish	- 3
000	180	319	139	240	060	270	090	120	300
005	185	324	144	245	065	275	095	125	305
010	190	329	149	250	070	280	100	130	310
015	195	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									
4 - 1	1 - 4			4 - 3	3 - 4	Signal	Pin -	3 -	Finish
3 - 2	2 - 3	4 - 2	2 - 4	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

60° Trapezoid Course Lengths to Marks and Course Lengths – Equal beats 1-2 two thirds of beat length
Start 0.05 nmi downwind of 4S/4P(4) and Finish 0.15 nmi from3S/3P(3)

Leg lengths (nmi)		
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 (nmi)		
I1	I2	I3
O1	O2	O3
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



I1 Start – 1 – 4S/4P – 1 – 2 – 3P – Finish
I2 Start – 1 – 4S/4P – 1 – 4S/4P – 1 – 2 – 3P – Finish
I3 Start – 1 – 4S/4P – 1 – 4S/4P – 1 – 4S/4P– 1 – 2 – 3P – Finish

O1 Start – 1 – 2 – 3S/3P – 2 – 3P – Finish
O2 Start – 1 – 2 – 3S/3P – 2 – 3S/3P – 2 – 3P – Finish
O3 Start – 1 – 2 – 3S/3P – 2 – 3S/3P – 2 – 3S/3P – 2 – 3P – Finish

25 Setting Windward-leeward courses (Courses Wn and Ln)

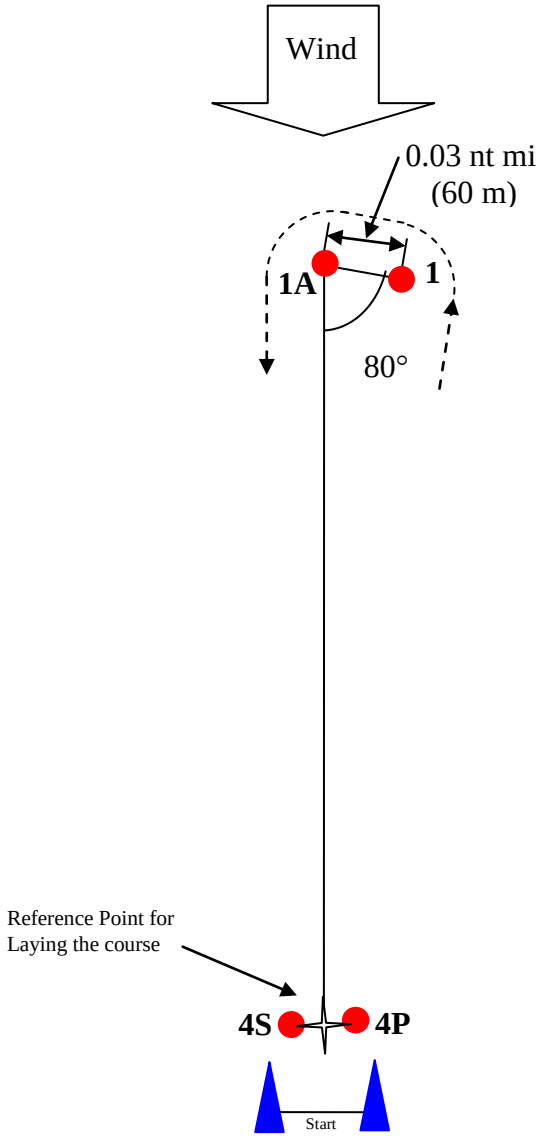
1. This procedure assumes availability of a signal boat, a windward mark boat and a boat that doubles as leeward mark boat and pin boat.
2. PRO determines course location, and Signal Boat anchors.
3. Signal Boat determines reference point location and radios it to mark boats (Mark Boat 1 and Mark Boat 2/Pin Boat) to lay gate marks, giving course major axis, gate width and starting line length.
4. Mark Boat 2 / Pin Boat or both mark boats lay leeward gate, as requested by PRO (see articles 11 and 12).
5. Signal boat radios heading and distance for Mark Boat 1 to proceed to lay offset mark (1A). When Mark Boat 1 reaches that location, she radios back to signal boat, confirming her location and that she is looking directly downwind at the center of the leeward gate. Mark Boat 1 gives drifting wind direction and speed reading to signal boat. She makes any required adjustment to her location to be directly upwind of the center of the leeward gate at the given range.
6. Mark Boat 1 requests permission to lay the offset mark (mark 1A) and, when laid, she radios its coordinates to the Signal Boat.
7. Mark Boat 1 proceeds to lay the windward mark (mark 1) as per Article 9 herein.
8. Meanwhile, Pin Boat works with the Signal Boat to lay the starting line (positioning herself at the port end, at the length given by the RO).
9. Mark Boat 1 radios the coordinates of mark 1 to the signal boat, when set.
10. If Course L is also being set, Mark Boat 1 proceeds farther to windward until she reaches the distance given for mark 1L. She lays Mark 1L when she is looking directly downwind at mark 1A and the center of the leeward gate. She radios the coordinates of mark 1L to the Signal Boat.
11. Mark Boat 1 stands by mark 1L to record mark roundings, unless otherwise requested by the PRO.
12. Once all the classes have started, Mark Boat 2 / Pin Boat lays the finish pin about ten boat lengths to starboard of the Signal Boat at an angle of 90 degrees to the major axis of the course. If practical, she leaves a small buoy on her anchor rode, rather than retrieving it, to facilitate taking the starting pin position for the next race.
13. Mark Boat 2 / Pin Boat takes up a position to record roundings of the leeward gate (4S, 4P), unless otherwise requested by PRO..

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

Leg lengths (nmi)	
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 (nmi)			
W1	**W2**	**W3**	**W4**
1.13	2.16	3.19	4.22
1.33	2.56	3.79	5.02
1.53	2.96	4.39	5.82
1.73	3.36	4.99	6.62
1.93	3.76	5.59	7.42
2.13	4.16	6.19	8.22
2.33	4.56	6.79	9.02
2.53	4.96	7.39	9.82
2.73	5.36	7.99	10.62
2.93	5.76	8.59	11.42
3.13	6.16	9.19	12.22
3.33	6.56	9.79	13.02
3.53	6.96	10.39	13.82
3.73	7.36	10.99	14.62
3.93	7.76	11.59	15.42
4.13	8.16	12.19	16.22
4.33	8.56	12.79	17.02
4.53	8.96	13.39	17.82
4.73	9.36	13.99	18.62
4.93	9.76	14.59	19.42
5.13	10.16	15.19	20.22
5.33	10.56	15.79	21.08
5.53	10.96	16.39	21.82
5.73	11.36	16.99	22.62
5.93	11.76	17.59	23.42
6.13	12.16	18.19	24.22

W1 Start – 1 – 1A - Finish
W2 Start – 1 – 1A - 4S/4P – 1 – 1A - Finish
W3 Start – 1 - 1A – 4S/4P – 1 – 1A – 4S/4P – 1 - 1A – Finish



26 ***Mark Boat Officer Competences***

Mark boat officers should be able to consistently demonstrate performance of the following **in rough conditions of open water, winds up to 25 knots with 2 m waves and current up to 2 knots in any direction**

Boat handling - be able to:

1 operate a power boat in rough conditions
2 standby 5 – 10 yards from a fixed object (an anchored mark)
3 standby 5 – 10 yards from a drifting object (yacht or person)
4 steer to a given compass direction.
5 steer to a waypoint given the bearing and distance from a reference position.
6 steer to a waypoint given by latitude and longitude.
7 come along side an anchored boat in **reasonable** wind and sea conditions to safely transfer objects and people.
8 come along side a wharf or jetty.
9 anchor in the intended position taking into account current, wind, waves and water depth.
10 retrieve the boat's anchor using a retrieval ball within 2 minutes of being given the instruction.

Mark Laying - be able to:

11 inflate and deflate marks in no longer time than would be taken on land.
12 lay a mark within 20 yards of a given position consistently, without problems within 2 minutes, with the mark upright and with allowance made for current, waves and wind.
13 retrieve a mark (anchored in 100 ft. of water) when standing nearby within two minutes of being given the instruction.
14 retrieve a mark using the retrieval buoy method. [Not used for this regatta]
15 read the supplied tables to obtain the distance and bearing to the reference point of each mark of the course given the course axis and the distance to mark 1
16 stream and tow a mark to facilitate dropping in a desired position. (e.g. for a gate mark, start mark or finish mark)
17 be one of two boats to lay a pair of gate marks the correct distance apart and at the correct angle, with allowance made for current, waves and wind.
18 correct a gate mark position to achieve the correct orientation and distance.
19 replace a mark with a small buoy and vice versa.

GPS Usage – be able to:

20 enter a latitude and longitude of a given position.
21 enter the boats position into the GPS using the Mark function ("ping" a position)
22 rename waypoints
23 save a new waypoint given a range and bearing from an existing waypoint
24 use the MOB function to identify a reference position
25 retrieve from the GPS the latitude and longitude of saved waypoints and present position.

Laser Range Finder Usage – be able to:

26 Set a laser range finder to yards and be able to use it to find the distance to an object.

Recording – be able to:

27 measure and record wind speed and direction from a drifting boat and graph to obtain trends.
28 measure and record current data
(i) using a tide stick
(ii) using the GPS in strong current.
29 record mark roundings with times.

Using a radio – be able to:

30 use correct procedures when transmitting and receiving radio communications.

Signal RRS information during a race – be able to:

31 anchor in the correct position to signal a course change, shorten course, or substitute for a missing mark.
32 know the correct flags and signals (visual and sound)
33 signal Postponement or abandonment.
34 display the correct signal within 30 seconds of the instruction.