

IYC Markset Guidance

Draft of 2022-09-27

This document describes how to set and retrieve marks for Island Yacht Club on the David Buoy, the club's white whaler, for sailboat races in the Alameda Estuary. The David Buoy is 13' long, 5' wide, and powered by a tiller-controlled 25 HP Mercury outboard

Safety

Your are responsible for your safety and the safety of others.

Safety should be the top priority when doing markset or driving the David Buoy. People are injured or killed every year on California waterways, and worse, they kill innocent bystanders too. Even from seemingly innocuous decisions: do a web search and read up on the death of Ethan Isaacs, age 10, at the Sarasota Sailing Club in Florida in late 2020.

Different news stories have slightly different versions, but there was an 18 year old instructor alone in a whaler. The instructor went to rescue a little kid in a capsized Opti. While doing so, a wave came and knocked the instructor off balance. The instructor fell backwards into the throttle, before either falling down in the boat or falling overboard. With the engine in gear, the whaler roared off up the course and the propeller chopped up Ethan Isaacs, and possibly other other little kids, before anyone could stop it. Ethan died. The settlement was north of \$10M.

Please reflect on that story and imagine yourself in the role of the 18 year old instructor. Or the parents. Or the Sarasota Sailing Club officers.

Note that in the wake of the Sarasota accident and others like it, it is now mandatory in the US for drivers of motorboats under 26' with more than 3 HP motors to use an automatic engine kill switch. Search the web for "US Coast Guard Engine Cut Off Switch" and you will find more material.

The markset driver should be careful to make sure the crew is seated and holding on before accelerating. Before accelerating, or decelerating, the driver should tell the crew that what they are going to do and remind them to hold on. The crew should be careful to hold on, and help balance the boat.

The David Buoy is a small boat, with a big engine. Don't go full throttle forward. Don't use much throttle at all in reverse (you could swamp it).

In general, there is no need to drive very fast. Unless there is a safety emergency that requires going fast, drive at a speed that is safe and comfortable for everyone. The Estuary also have

several no wake zones, mostly along the south side, so please be respectful of the houseboat owners that berth there and keep to the north side when moving quickly.

Everyone should keep a good lookout. The Estuary has kayakers, rowers, small boat sailors and swimmers. Plus debris.

Check gear, your personal gear and the David Buoy's. Wear your lifejacket and protective gloves. Bring a cell phone so you can call 911 in an emergency, or someone else in a not-quite emergency. Bring a VHF radio so you can call the Coast Guard. Double check there is at least 1/5 of a tank of gas before you set out by moving the seat and picking up the tank. (As a courtesy to the next driver, confirm there is still at least 1/5 of a tank when you put the boat away, and refill to 4/5 of a tank if there is not.)

As a reminder, the Coast Guard's mission is to protect life, not property. They will respond if a boat is sinking or someone is in the water and cannot be recovered, but short of that they will usually just put out an alert for other mariners to assist if possible.

If you do have to call the Coast Guard, hail them on VHF channel 16. There are three attention-getting phrases to use.

- *Mayday* for imminent danger to life, like a boat is sinking or someone is in the water and cannot be recovered.
- *Pan Pan* for danger, but not quite as imminent. The usual example is a boat out of power and drifting toward a rocky lee shore.
- *Securite* for a safety hazard warning to other vessels. For example, a 40' log or portion of a dock floating in the water that will seriously damage any boat or ship that runs into it.

Keep your radio on dual watch with channel 16 and perhaps you can help someone.

In a serious emergency, like someone having a heart attack or getting chopped up by the propeller, call 911. Or the Coast Guard, but in the Estuary the author suggests 911.

Do inform a club officer or the PRO if there is an emergency. But do so only after reaching out to 911, because the club officer or PRO can't help you revive someone or control bleeding. Call 911 first.

Response is unlikely to be instant. There is a story of a boat getting into trouble on the west end of Coast Guard Island and it taking an hour for the Coast Guard to arrive --- coming from the the east end of the island. On the other hand, that was not a imminent danger to life, either.

In a non-emergency, like running out of gas, if you cannot paddle somewhere useful, contact a club officer or the PRO. Perhaps they can find someone to come help you out. But that will likely take a while too. Plan on anchoring and waiting an hour or two.

If you can get to shore in an emergency, do so. If the engine dies very near shore or a dock, use the paddle: as a small whaler you can maneuver a little with a paddle. If you cannot motor and you cannot paddle, you should immediately think of anchoring. It is a markset boat, so there are often lots of anchors. Note that the anchor setup for a mark is different than the anchor setup for a boat, so the mark anchors are smaller and lighter and have less scope than ideal for anchoring the David Buoy itself. Tie two or more anchor lines together with your best bowlines to get more scope.

This is not intended as an exhaustive safety discussion, but it is important to emphasize:

Your safety depends on you.

Departing the Dock

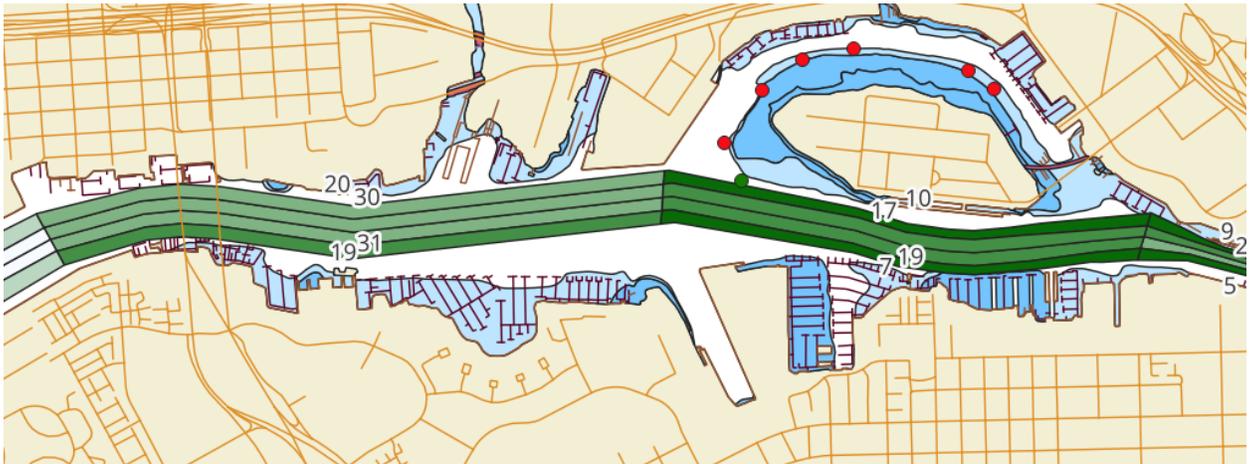
Logbook / Checklist

General Driving

The Estuary

- We use the Estuary from roughly Jack London Square to almost the Park Street Bridge, which is a little over 2 nautical miles
- From Jack London Square to the east end of Coast Guard Island, the Estuary channel is about 600-650' wide in the narrowest parts, docks to docks. Further west, the Estuary is as much as 1400' wide from the west side of the mouth of Encinal Basin to the west side of the mouth of Brooklyn Basin.
- According to the NOAA vector chart US5CA13M circa summer 2022, the Estuary is dredged to a depth of roughly
 - 20' in the middle of the channel opposite the Coast Guard pier up to the west side of Brooklyn Basin
 - 30' in the middle of the channel from Brooklyn Basin up to Jack London Square
 - 50' in the middle of the channel from Jack London Square to the bay
- That said, the coast guard cutters draw 22' feet.
- In practice we expect to see these depths taper and not make the sudden jumps shown in the NOAA chart.

- Summer 2022 chartlet with dredged areas in shades of green (darker=shallower) and depths in feet:

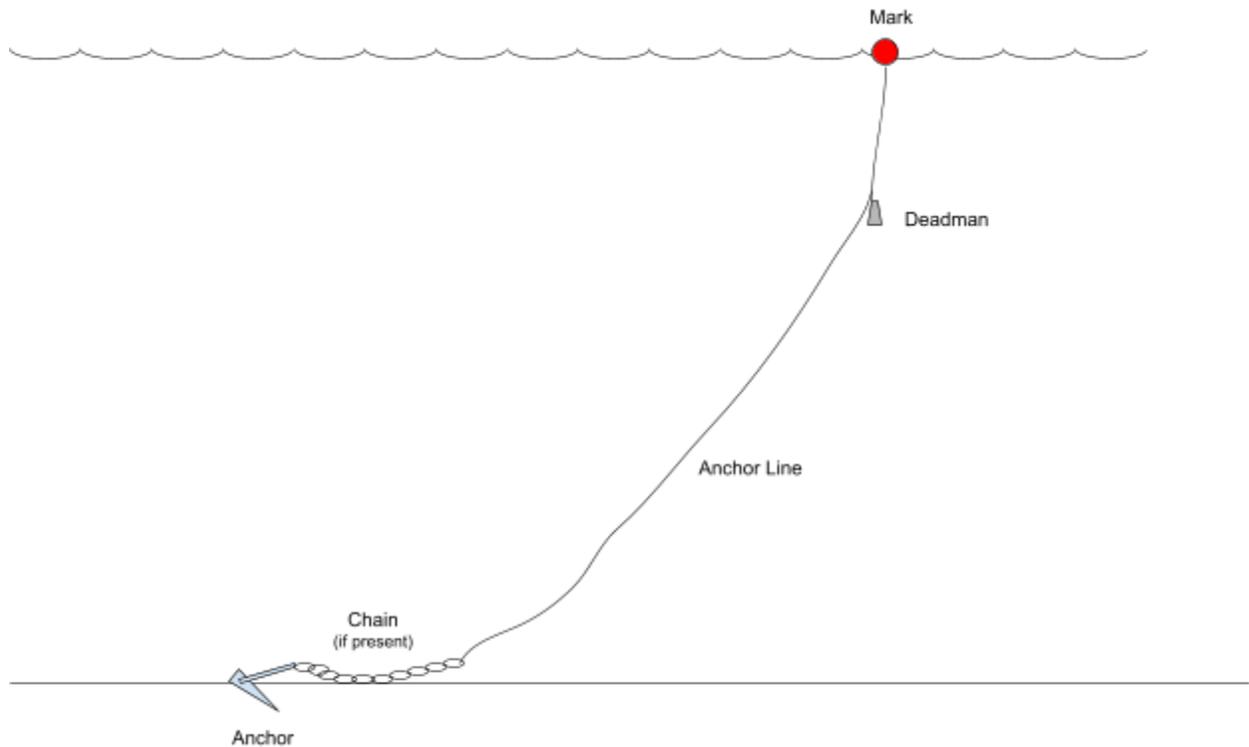


- Please use the longest anchor lines for the marks furthest to the West.

General Information on Marks

- At IYC, marks have historically been 15-24" diameter permanently inflated red-to-orange ball fenders, which are practically indestructible.
- In mid-2022 Theo donated some large (5' x 3'?) thin-walled inflatable yellow cylinder marks, which require special care and training to use. (Several club members are opposed to using them as too much work and a potential safety problem if not given careful attention.)
- Ball marks are already attached to anchors and deadmen on reasonable length rodes for the Estuary. One rode is a bit longer -- if possible, use that for the mark furthest up (west) in the Estuary.
 - If we're good we might mark the rode lengths not including the chain that is supposed to lie completely on the bottom.
 - One band of electrical tape colored red every 50' feet
 - Band of black every 10'
 - Band of blue every 5'

- Diagram of a mark in the water:



- A racing mark should always have a deadman (which is just a weight) placed on it, to ensure the line closest to the surface goes more-or-less straight up and down, rather than directly to the anchor. This helps prevent a sailboat going close around the mark from catching its keel on the anchor line. The deadman should ideally be a little deeper than the deepest keel, but beware of going too far: the further down the deadman is, the further up it must be pulled in by hand during mark retrieval.
- Below the deadman, the anchor line will connect to the anchor chain, if there is one. The chain is helpful to ensure the pull on the anchor is along the bottom, which helps the anchor grip better. A longer, heavier chain provides more holding power, but is also more effort to pull up.
- Below the chain (if present) is the anchor itself. The club has a variety of anchor types: Danforth, grapple, Bruce, and perhaps others. The heavier the anchor, the more holding power, but also the harder to retrieve by hand.
- The ratio of anchor line length to water depth (scope) for marks is very short by anchoring standards, typically 1.5:1 to 2:1. The short scope means the buoy will move less relative to the anchor if the wind or current shifts. And the less line to pull in. And the easier to tug the anchor free of the bottom.
- We want the lightest deadman, chain and anchor we can get away with using, as that is the easiest to retrieve.
- But we do need enough weight on the deadman to keep the anchor line down from the mark to the deadman.
- And we need enough chain, and/or anchor weight, to keep the buoy anchored.

- Other clubs use heavy gear
 - St Francis will use a 28 lb anchor with 5-10 lb of chain and a 8-10 lb deadman
 - South Beach uses a 28-30 lb anchor with 10+ lb of chain and one or two 10 lb each deadmans to hold the buoys upright in the water with the anchor rode straight down from the mark.
 - Both clubs have to use the “anchor yanker” retrieval system to avoid exhausting the 2-3 people they have on the markset boat.
- We are in shallower water with less current and wind, fewer markset crew, and no “anchor yanker.” And we have historically just used little ball buoys. So we have gotten away with using a ~5 lbs anchor, ~2 lbs of chain, and 2-4 lbs deadman.
- But it’s always good to understand the math, especially if we consider using bigger cylinder marks to give the racers improved visibility of where they are supposed to go.
- There are two forces on the buoy that the deadman and anchor must resist: wind dragging the buoy downwind, and current dragging the anchor line and deadman and the bottom of the buoy down current. For this discussion, ignore the current drag on the deadman and bottom of the buoy.
- Drag forces are $\frac{1}{2} (\text{fluid density}) * (\text{drag coefficient}) * (\text{cross-section area}) * \text{velocity}^2$.
- Converting to metric, doing the math there, and converting back if needed, is usually less error-prone, so here are the relevant ballpark numbers in metric units:
 - Density of water is 1000 kg/m³
 - Density of air is 1.225 kg/m³
 - Drag coefficient, for our purposes, is 1.0 for the rough anchor line and around 0.7 for the buoy
 - A 15” diameter ball has a cross section of 0.11 m²
 - A 24” diameter ball has a cross section of 0.29 m²
 - A 5’x3’ (?) cylinder has a cross section of 1.4 m²
 - A 1/4" line that is 50’ long has a cross section of 0.097 m²
 - Each knot of wind or current is 0.51 m/s
 - A good breeze is ~15 knots or ~7.5 m/s
 - A pretty strong current in the Estuary is ~1.5 knots or ~0.75 m/s
- Putting that all together,
 - 1.5 knots of current on 50’ of 1/4" line produces a 27 Newton force downcurrent
 - 15 knots of wind on a 24” ball produces a 7 Newton force downwind
 - 15 knots on a 5’x3’ cylinder produces a 34 Newtons force downwind
- So we’d expect a 5’x3’ cylinder to need a deadman almost 5 times heavier in the water than the 24” ball would use, to have the same effect. And we’d want an anchor capable of holding ~1.8 times as much tension without dragging.
- Ignoring the deadman to keep the math simpler, at a 1.5:1 ratio of anchor line length : depth, we’d expect the buoy to be anywhere in a circle with radius 75% of the length of the anchor line, centered above the anchor --- most likely on the downcurrent or downwind side of that circle, depending on the relative strength of the two forces.
- At a 2:1 ratio of anchor line length : depth, we’d expect the buoy to be anywhere in a circle with radius 87% of the length of the anchor line, centered above the anchor ---

most likely on the downcurrent or downwind side of that circle, depending on the relative strength of the two forces.

- Club marks are stowed with the line closest to the buoy in the bottom of the milk crate, and the line closest to the anchor on the top. This facilitates the “anchor drop” that the club has historically used for all its drops, and will always want to use for the majority of the marks going forward.
- Ideally, the starting pin will be set last with input from the PRO. Re-flaking the anchor line to put the part closest to the anchor on the bottom and the line closest to the buoy on top will allow for a “streaming” drop, which the club has not done much, but gives better control over positioning.

Notes on “Big” Marks

The club has an assortment of “small” marks, in the form of fender balls of less than 24” diameter. Those are made of thick plastic, stay permanently inflated, and are nearly indestructible.

In July 2022 Theo from EYC donated six big West Marine inflatable marks, made of thin plastic. They must be inflated before every use, and deflated afterward. These marks are pretty fragile, because they’ll puncture or scuff easily. And if / when they break, we’ll lose our anchor, anchor line and deadman too.

Big marks are most useful at the upwind mark location(s) so they can be seen from very far away, looking into the glare of the setting sun on the water. It is OK if the start pin is small, because everyone is right there, no glare, and so the start pin should be the smallest mark we set. The leeward mark is well lit by sun coming from behind the racer and should be medium-sized.

The first thing to note about big marks is they should never be completely filled full of air: the sun will heat them up, the air inside will expand, and they can “pop” just from that if they are already full. And then we’ll lose not just the mark, but the line and the ground tackle too. Make sure a gentle hand press can easily make a big dimple in the mark, don’t make them full.

On a big mark it is important to get to the bottom attachment point when doing retrieval. But the mark itself is big and hard to grip. So one line, or two lines, are often tied from the top of the mark to the bottom as “belly” lines -- if you can grab on to one of them you can pull up on it to flip the mark on its side and get to the bottom attachment point. But the belly lines are often not enough for easy retrieval because there is only one, or two, of them and by Murphy’s Law there is never one right where you are. So a “waist” line is usually tied to the belly line(s) around the middle of the mark. When you retrieve, you grab the waist line to rotate the mark around the vertical axis until you can get to the belly line, and then pull up on the belly line to rotate the mark around a horizontal axis until you can get to the bottom. Once you have control of the bottom you are in control of the mark and its anchor line.

For our marks, there may be a belly line but perhaps no waist line. Which might be fine, or might be cause to add a waist line, depending on how easy the mark is to rotate to the belly line currently.

A deadman is a counterweight placed below the mark to hold it upright -- and the deadman should be placed about 6' to 8' below the mark, on the anchor line, so that the anchor line goes straight down from the mark before angling off to the anchor. When a sailboat with a deep keel goes around the upwind mark, we would prefer the keel didn't catch the anchor line because that is painful for everyone. It's painful for the boat who snagged it and might have trouble dis-engaging. It's painful for the boats behind them who need to round the mark if only the boat that snagged it would get out of the way (or stop dragging it). It's painful for the mark-set boat that needs to re-set it. And it's painful for the RC and protest committee people that need to figure out redress, if any.

So a deadman will typically be on 6' to 8' of line with two snap shackles. One snap shackle right at the deadman clips onto the anchor line and the other snap shackle 6 to 8' away clips onto the bowline-with-safety at the base of the mark.

A bigger mark also needs heavier ground tackle than a smaller mark, because it has more windage pulling it downwind.

For those who like to see the math and do the numbers, the drag force (in Newtons, 1 N = 0.225 pound-force) is

$$F_d = \frac{1}{2} \rho u^2 c_d A$$

Where density is 1.225 kg/m³ for air

Velocity is in meters / second, where 2 knots is very close to 1 meter per second

The drag coefficient is around 0.7

And the area is the projected area, πr^2 for a spherical ball, and $2r \cdot h$ for a cylinder, one foot = 0.3048 meters

Just thinking about the area, not the numeric value of the force, a 3' diameter, 4' tall cylinder has four times the drag as a 24" diameter ball. A 52" diameter, 72" tall cylinder has eight times the drag.

There's also more torque on big marks, so it's important for them to be on a swivel between the base of the mark and where the anchor is attached.

Marks this big don't go into a dinghy, usually. They get towed behind the boat. When the boat is close to the drop location the deadman is hooked up and then the mark is dropped, by either the anchor or streaming drop technique.

Towing requires a good cleat, so the mark set boat will need a good cleat if it does not have one now.

To deflate a big mark, open the port and then use the "suck" side of a shop vacuum to pull the air back out quickly.

Launching the Markset Boat

This material is from Eric K, and may be obsolete if we can keep the markset boat in the water.

Launching the boat is an easy task, best accomplished with 2 people, but very doable with one person.

1. You will need a hitch with ball size 1 7/8".
2. The boat and trailer weigh approximately 500lbs and almost any car or truck should be able to safely tow it.
3. The boat located on the corner of Park and Buena Vista street, it is in a fenced in area of the parking lot (adjacent to Mcgees)
4. The entrance on Buena vista has a combination padlock. Talk to a club officer for the code.
5. Back in and connect the trailer, there is a dolly to help if needed.
6. The keys for the hitch lock are also important. Get them after discussion with a club officer, and be sure to return them to where you got them.
7. Remove the covers for the outboard and the boat, and place them behind with the spare tire on top so they don't blow away.
8. Close and latch the hitch and attached the safety chain, and connect the lights.
9. The launch ramp is located at the end of Grand Street, turn left on Buena Vista and it is about 1 mile away.
10. When backing the boat turn the bottom of your steering wheel in the direction in which you wish the boat to go.
11. Back the boat down the launch ramp far enough that the boat just begins to float.
12. Be sure to put you car in park and set the parking brake.
13. Connect the fuel line (gray) and squeeze the hand bulb until it is firm. Start the outboard in the water before you unhook the boat from the trailer (get the key from the same place as the hitch key).
14. To start the outboard, make sure the control handle is in the center, you may need to lift the choke, which is the metal handle directly above the key.
15. Once started and running, disconnect the boat from the trailer and tie up to the dock.
16. Park the trailer.
17. Take the chase boat to pier 5 at Alameda Marina or wherever was decided.
18. Be sure to tie it securely to the dock and put the key(s) back.

Setting Marks

For safety's sake, we'd really like to have two people aboard the markset boat.

Also for safety, and ease in communication, someone aboard the markset boat should have a VHF radio and tune it to the RC channel.

The markset crew should also have a copy of the sailing instructions, and a GPS.

Marks need to go where the Sailing Instructions say they'll be. It is an error, and good way to have competitors haul the RC into a protest (redress) hearing, if the marks are in the wrong spots. Especially under time-on-distance handicapping, because incorrect placement means the distances will be wrong, and thus the handicap allowance is wrong. And in turn the scoring and prizes will be wrong, potentially.

If the Sailing Instructions say the marks are a given shape or color, that is extremely helpful for the competitors to make sure they are going around the right mark. But then the marks need to be that shape or color.

If the color or shape do not match the SIs, the PRO can potentially "fix" that by announcing the change on the water --- if the SIs allow on the water changes.

General

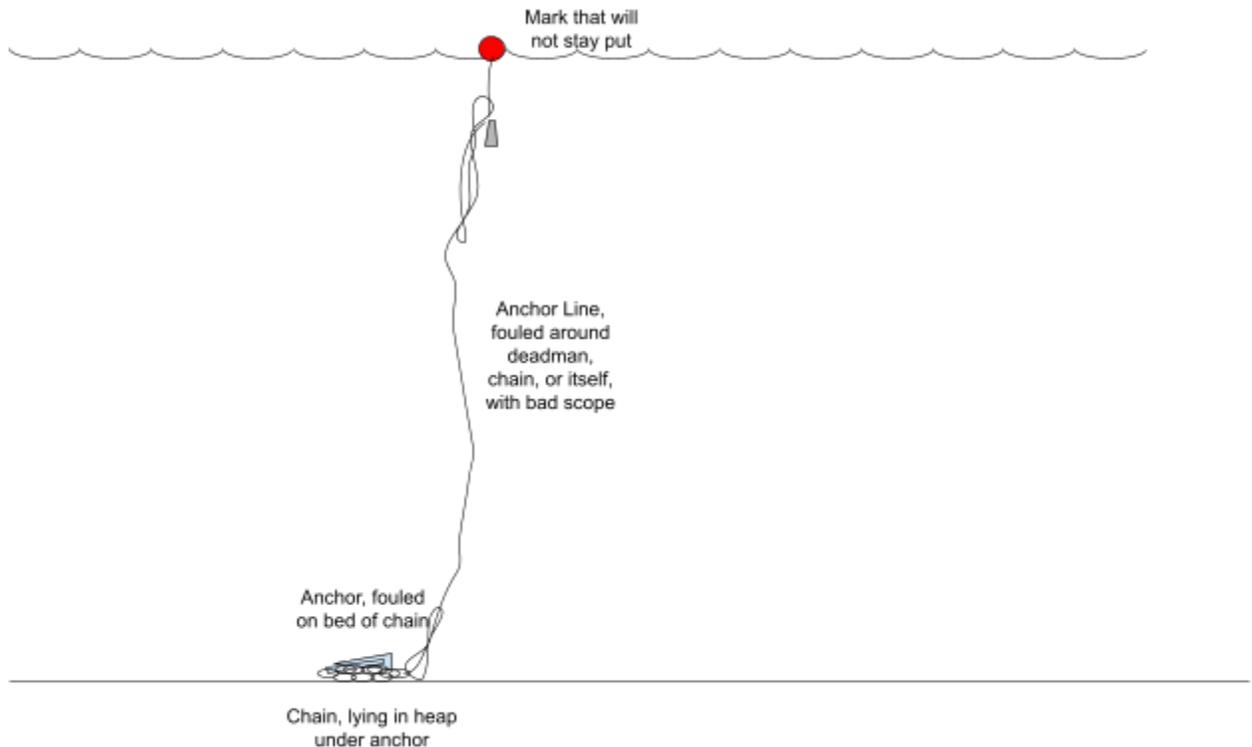
- Marks need to go where the sailing instructions say they are going to be --- which can vary between different regattas or different years. **Be sure you are looking at the right sailing instructions when setting marks..**
- The race organizer may have created GPS positions for the mark locations that go with a given set of sailing instructions. If those are available and you have a GPS to use them, please put the ANCHOR at the given locations via an anchor drop. Putting the anchor at the right place minimizes how far the actual buoy will be pushed away from the desired position by wind or tide. And since wind and tide will often behave the same for all the buoys, they'll all shift the same direction, preserving distances. **Be sure you are using positions for the right sailing instructions.**
- Mark positioning must be more accurate for races run under "time on distance" handicapping than races under "time on time" handicapping. If the positions are wrong in ToD, the time allowance is wrong, which means the scoring and prize-awarding is potentially wrong. As of Sept 2022 there is a desire to switch to ToT handicaps, which will eliminate scoring problems. Regardless of handicapping, racers still expect to find marks where they are supposed to be in the sailing instructions, and can protest the race committee if they're somewhere else.
- Note that we do not want to publish anything that sounds like official GPS coordinates of the marks (if we have them) because we do not want the possibility a racer could protest the race committee on the grounds that the mark was supposed to be at GPS position X

and it was at GPS position Y. (The odds of this happening are low, but the advice from a longtime PRO at Golden Gate and EYC was to never publish locations to eliminate any risk.)

Anchor Drops: The Basic Workhorse

- As mentioned earlier, use anchor drops for most marks, putting the anchor at the position given by the sailing instructions.
- Before attempting the drop, be sure you know which way the boat will be pushed by the combination of wind and tide. Setting should happen with the boat getting pushed away from the anchor line, not toward it, so knowing which way that will be is critical.
- If something looks wrong or is going wrong, it is almost always better to abort and start over than try to do something impromptu or desperate. Take your time and avoid something that could increase the chance of an accident.
- The driver will drive to the approximate position of the mark, and the crew (or driver) will help navigate to the right spot.
- As the boat nears the right spot, the driver uses low power to move slowly into position from the direction opposite the direction the boat will be pushed if/when the power is off. So if the dominant force is the wind, blowing the boat to the west, the driver should approach slowly from the east.
- At the right spot, the driver keeps the bow upwind while ideally holding position against the shore. If this is too tricky, the driver should go to neutral.
- From the bow or as close to the bow as practical, the crew rapidly lowers the anchor, then the chain, then the line.
- The crew indicates when the anchor has hit bottom. That is the signal that the driver can go into neutral, if not in neutral already, and let the boat drift away from the anchor line.
- As the boat drifts away, the crew pays out the remaining line, then the deadman, and finally the buoy
- The crew should lower the anchor rapidly, but it's lowered, with a little tension to ensure it goes out in a nice orderly way. Do not dump the anchor and chain, or chain and line, overboard all at once. If everything is thrown over at once, the anchor tends to "glide" down on its flukes while the chain plummets. Which means the anchor often lands on the chain and not on the bottom, which in turn prevents the flukes from digging in. If too much line is let out all at once, it can get tangled up in itself, the deadman or the chain, and then the scope is too low. Either of those problems, much less both, will produce a mark that is pulled along with current or wind instead of staying put like it is supposed to.

Illustration:



- It's also extremely important to keep the anchor line clear of the propeller. Easing out the line from the bow or amidships under a little tension, rather than dumping, ensures there's no slack to entangle the prop. Keeping the bow upwind / upcurrent and letting the boat drift back once the anchor is on the bottom also helps keep the anchor line from fouling the prop.
- If there's any concern about the boat bearing down on a line, immediately go to neutral to avoid a prop wrap.
- If the driver knows exactly where the line is, it's possible for a really good driver with good crew to go into reverse to get away from the line, but this only works if done early enough and is dangerous to try late. Consider this an extra-advanced technique for experts only.

Streaming Drops: Advanced Technique for Start Line Buoy

- As mentioned earlier, use a streaming drop for the start line buoy if the PRO is there and can signal when to drop.
- Figure out which way the mark will be pulled from the anchor. As a first guess, you can assume it will be the way the boat gets pushed by wind + tide if you slow the boat down to near idle. If the guess is wrong, either the PRO will have to live with an error of around 1.5x the length of the anchor line, or you'll have to pick up the mark and try again.
- Markset crew re-flakes the anchor line from the usual anchor-out-first way it is in the crate to the reversed buoy-out-first way used in a streaming drop.
- Markset driver approaches from downwind (or downcurrent if appropriate).

- Markset crew starts paying out the buoy, then the deadman, then the line while holding the line so it stays well clear of the engine, as the driver moves VERY slowly upwind, at 1/2 knot or less, turning slightly toward the side with the buoy so it streams out to aft and to the side. It's very important the driver not go at all fast or the line can pull through the crew's hand and then the crew or driver can get seriously hurt by the anchor. It's also possible to break a line and have the snapped-off end recoil and hurt someone.
- The line should be fed out with a half-wrap around a "barney post", which the David Buoy lacks, so use the mini-cleat at the bow.
- When the line is almost all the way out and only a few feet are left before the chain or anchor, the crew will secure the line more firmly around the mini-cleat at the bow, and hold out the line to keep it clear of the engine.
- The driver will continue to move ahead slowly
- When the buoy is in a good position the PRO will say "drop, drop, drop".
- The crew immediately releases the line and tosses the chain and the anchor off the side of the boat, trying to get the anchor forward and the chain aft. (The tension back to the buoy will tend to prevent the anchor from falling on the chain unless the chain and anchor are tangled during the drop.)
- If the drop needs re-tried, the driver should communicate with the crew to get the crew to firmly secure the anchor line around the cleat at the bow. Then the driver must drive slowly, with all turns to the side with the line, and try again.

Retrieving Marks

It's important to have two people on the markset boat for safety.

It's also important for safety, and ease of communications, for someone on board the markset boat to have a VHF radio.

Once the last start is off, the markset can check with the PRO to see if some marks are going to be unused. If so, they can be removed early, if desired.

It is possible to pick up mark before the race uses, before the race is completely over, to get a head start on pickup. The top marks can be picked up as soon as the last boat is safely around and well clear of the mark for the last time.

Of course it is a big problem if a mark is picked up before the last boat has rounded it for the last time. Only pick up marks after talking to the PRO to confirm there's no one who will be coming around for another lap!

Finally pick up the start / finish pin.

Pick up marks by coming along side and getting to the attachment point on the bottom of the mark. Either use the boathook (or a bow painter) for a small mark, or use waist and belly lines

for a big mark. Pull up the deadman, if any, and stow in the crate. Then pull up the anchor, coiling into the crate as you go.

Docking

Cleanup

Pulling the Markset Boat

See "Launching the Markset Boat."

Logbook

References

For further reading:

- St Francis Markset Manual
- CA Course for Safe Boating
- US Coast Guard "Engine Cutoff Switch" FAQ
- Sailing World and ___ on 2020 Sarasota Sailing Club accident that killed Ethan Isaacs.