

Sailing Basics

Version 2.0

for the
RC Sailor

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Introduction

Sailing can be described as flying on the air/water interface. The principals of movement through the water are similar to that of an airplane.

The sailboat has no ropes, and a language that describes every part so that there is no confusion at sea. Learning the language will make the process of becoming a safe and proficient sailor a much easier process. Practice will bring great benefits early in your learning to sail as it will build confidence in the boat and the skipper.

As a new RC sailor you are about embark in an activity that can be enjoyed at any age and can be shared with friends and family.

Smooth sailing...

Sailing Terms - Directional

Port – The left hand side of the boat as you look forward. If you are on the bow and are looking aft, the port side does not change, it is to your right side but is always determined from the direction of travel moving forward.

Starboard – The right hand side of the boat viewed looking forward

Fore (forward) – Any movement toward the front of the boat towards the bow

Aft – Any movement toward the back of the boat towards the stern

Bow – The frontmost part of the boat

Stern (Transom) – The aftmost (back) part of the boat

Beam – The widest part of the boat

Sailing Terms – Technical

OAL – Overall Length, length of boat from bow to stern, not including rudders

LWL – Length waterline, length of boat along the waterline, usually shorter than OAL

Draft (1) – Depth of the boat in the water from waterline to bottom of keel or centerboard

Draft (2)– Amount of curvature (belly) in a sail

Displacement – The amount of the weight of water displaced by the boat in the water, essentially the hole on the water a boat makes, the weight of the boat with all equipment aboard

Additional Sailing Terms

Tack (on a tack) – The heading of a boat moving anywhere from 45 to 80 degrees from the wind direction

Tacking – Steering the boat towards and through the wind to change from one tack to another (Port to Starboard or Starboard to Port). Under the rules you are tacking once head-to-wind until the sails are drawing on the other tack.

Gybe – The counterpart to being on a tack except going downwind

Gybing – Similar to tacking except heading downwind

Heeling – Having the boat lean over, on RC sailboats angles up to 35 degrees are OK on some boats but 15-25 degrees is more typical

Heading Up (Pinching) – Steering the boat more toward the wind, also lifted

Falling Off (Footing) – Steering the boat more away from the wind

Making Way – Moving through the water, not standing still

Over Trimmed – Sails in too tight

In Irons – No forward movement because a tack was made to slow, stalling the boat with the sails luffing

Windward – Being closer to the wind direction than another boat or object

Leeward – Being farther from the wind direction than another boat or object

Sailing Terms – Boat Parts

Mast – Vertical member that holds the sails up

Mast Crane – Device on top of the mast to allow for attachment of the forestay and backstay if present

Main Boom – Attached to the mast at the gooseneck, if holds the *foot* of the *mainsail*

Jib Boom – Rigid horizontal rod that attaches to the foot of the Jib

Stays – Any line that controls the mast in a fore to aft direction e.g. forestay, backstay

Shrouds – Any line that controls the mast in a left to right (athwartship) direction (also Spreaders that guide the Shrouds)

Halyard – A line that raises or lowers a sail and is specific to a sail, e.g. Main Halyard, attaches to the head of a sail

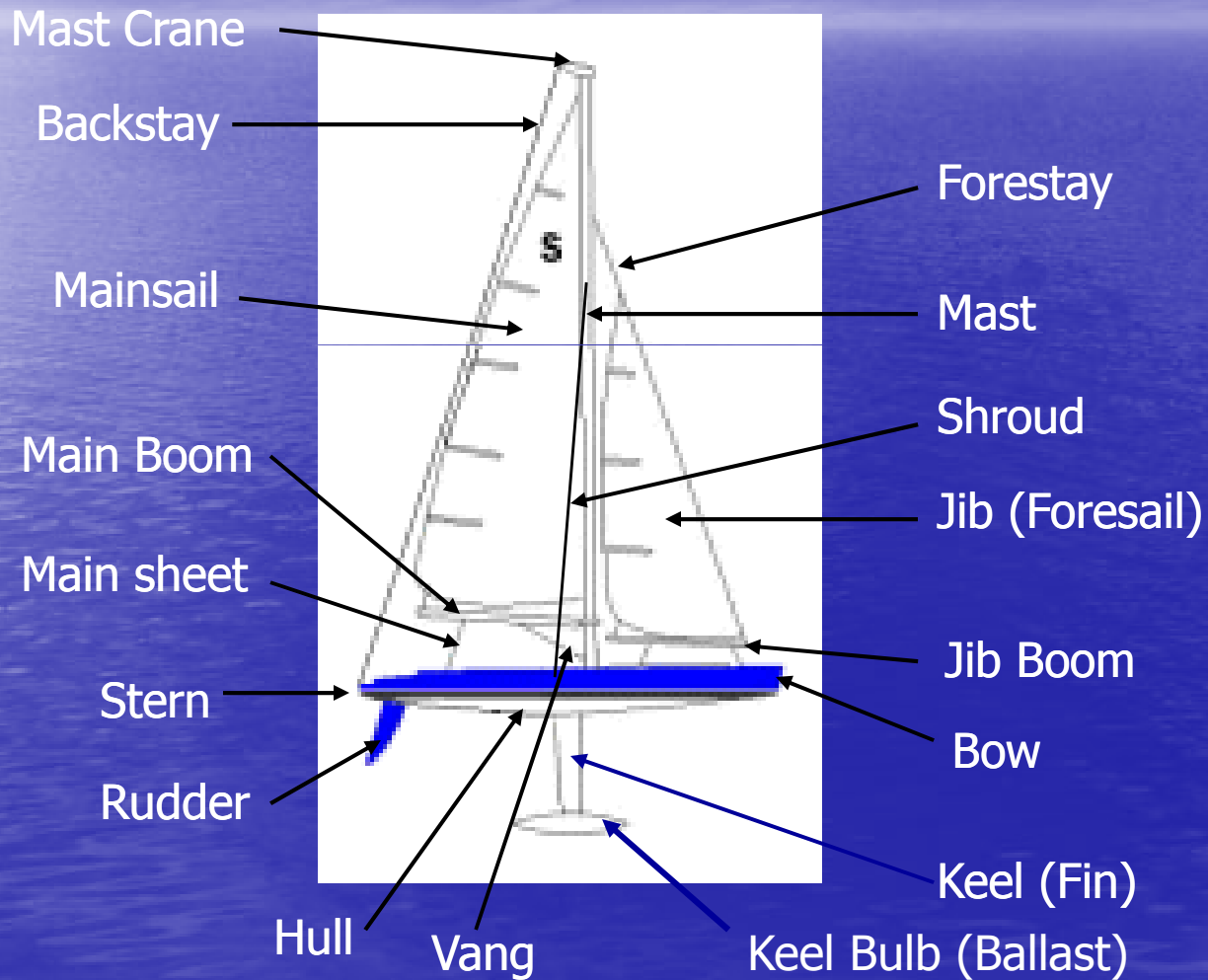
Sheet – Any line that controls a sail's lateral position and is sail specific, e.g. Jib Sheet

Rudder – Attached to the steering servo and is what mechanically steers the boat

Vang – Device attached to the bottom of the mast and main boom to control the height of the boom which effects sail shape

Boat Parts II

Boat Viewed from the Starboard Side



Sails – Jib (Foresail)

Head – Top of the sail, where the Jib Halyard Attaches

Tack – Attaches to the front of the jib boom

Clew – Where sail is controlled by outhaul and inhaul lines

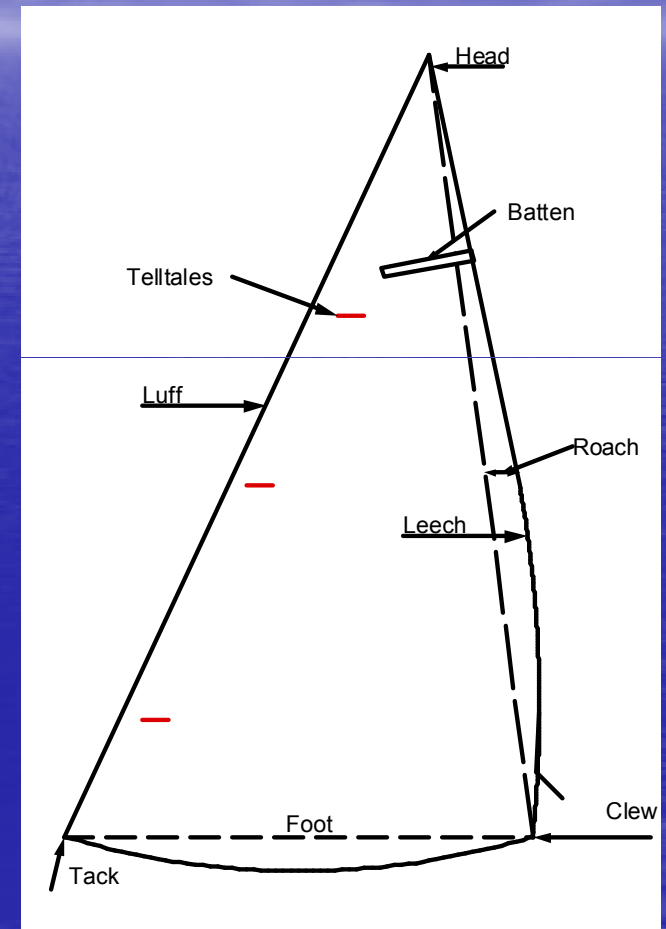
Batten – Stiffener to help sails stability

Leech – Trailing edge of the sail

Roach – Extra sail area along the leech

Foot – Bottom edge of the sail

Telltails – Sail trim indicators



Sails – Mainsail

Head – Where Main Halyard Attaches

Tack – Where sail attached to front of boom

Clew – Attached to the Clew Outhaul/Inhaul on the boom

Luff – Leading edge of sail attaches to Mast

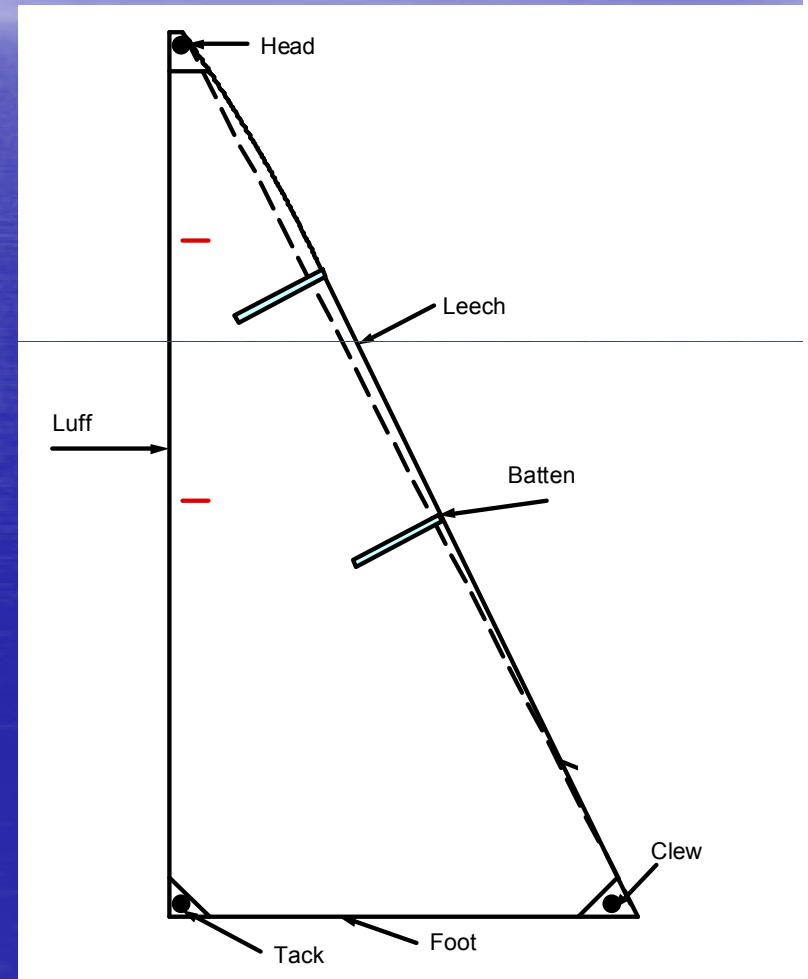
Foot – Bottom edge of sail, attaches to boom or is loose footed

Leech – Trailing edge of sail

Roach – Sail area between Leech and line between Head and Clew

Batten – Stiffens roach of sail

Telltale – Sail trim indicator

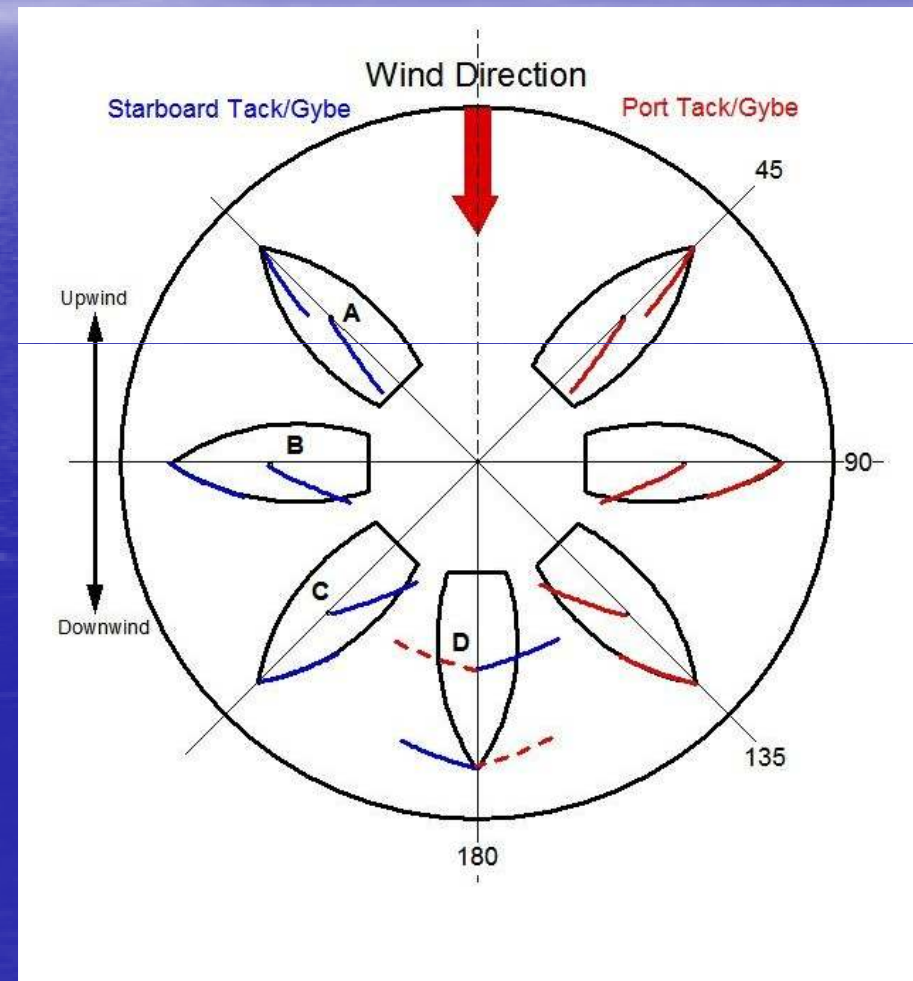


Points of Sail

- A – On a tack (Closehauled, beating, going to weather)
- B – Beam Reach
- Between A&B – Footing
- C – Broad Reach (on a gybe)
- D – Running – Dead downwind, wing & wing

Starboard Tack – When wind is coming across the boat on the starboard side and the sails are on the port side, has the right-of-way

Port Tack – Wind is coming over the port side, and the sails are on the starboard side the burdened tack



Simplified Sail Theory

As previously mentioned, sailing is similar to flying. The curvature of the sails are like the wings of an airplane that generates a flow called lift. This lift is the major factor in the boat being able to sail not just away from the wind but toward it.

Because of the shape of the sail required to generate lift a sailboat can only sail up to about 45 degrees from the wind, at less than 45 degrees the sails begin to flutter (luff). As you sail away from the wind (see previous slide) some part of lift remains but the wind pushing against the sails also supplies power to move the boat.

By making adjustments to the sails to add or takeaway curvature or adjusting the sails positioning to the wind more or less lift or power can be generated as conditions require.

Sail Trim and Rig Tuning

Many sailors will agree that the key to sailing your boat competitively is doing well after the start on the first leg. In the vast majority of cases this involves going to weather or sailing upwind on a tack. Generally you will sail greater distances and time going to weather than downwind so it is important to learn how to maximize your boat to sail upwind.

To use a a golfing adage “drive for show, putt for dough” and in sailing, sailing upwind is your putting.

A Starting Point – Balance

Before we go into the specifics of tuning and trim it important to discuss some of the factors of boat design and how the hull, mast and sails work together.

I use the word Balance to help illustrate all of the forces required to get your boat sailing straight on a tack with little or no use of the rudder. Once you understand this basic information you will have greater understanding of how and why all of the adjustments to the rig and sails can be used to help the boat sail better.

Volumes have been written about sailboat design, most of which requires advanced degrees to be understood, so we will keep this simple!

Balance – Hull Design

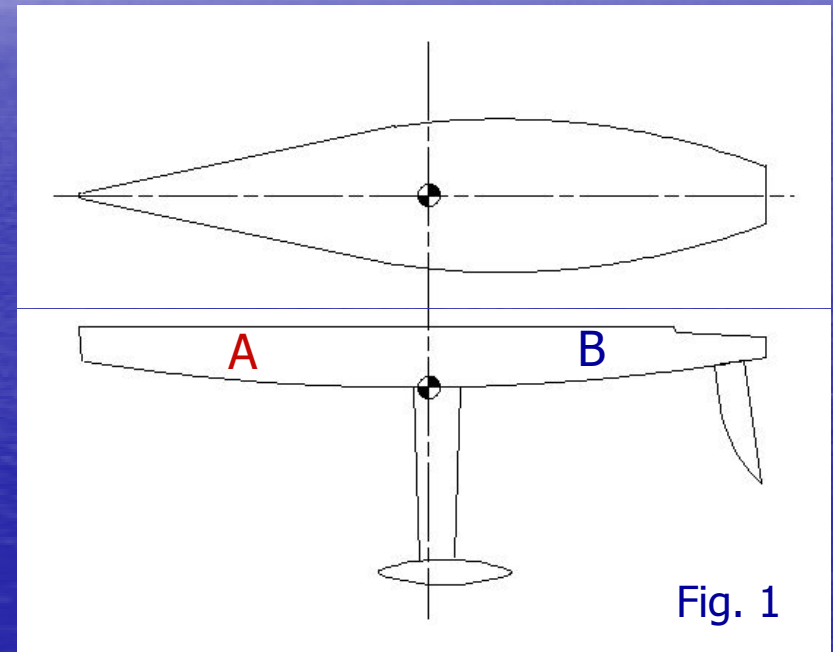
In fig.1 we see a typical hull with the keel, bulb and rudder. Also you will see a circle with centerlines on the views.

These circles and lines show the position of what is most often referred to as the Center of Lateral Resistance (CLR), or for our purposes, the Balance point of the boat.

So what does this mean? Imagine if you placed a rod down through the boat at the CLR and it came out through the bottom of the keel. You would be creating a windvane. If you pushed anywhere along the vertical line the vane would not rotate as this is the boats Balance or pivot point.

However if you pressed at any point in front of the CLR (A) the boat would rotate and if at (B) it would rotate the other way.

Pretty simple



Balance – Sail Plan

In fig.2 on the right you see a typical sailplan for an RC boat. In each of the sails you see dotted lines from the corners of the sail to the mid-point of the opposite side of the sail. The intersection of the points is the Center of Effort (CoE) for each sail.

By connecting the two centers of effort we start to determine the Balance point of the sail plan. In this example 60% of the sail area is in the main, the plan CoE is therefore 60% back along the line.

If both sails are equally trimmed the theoretical Balance point is along a line vertically through the Blue CoE.

Again, pretty simple

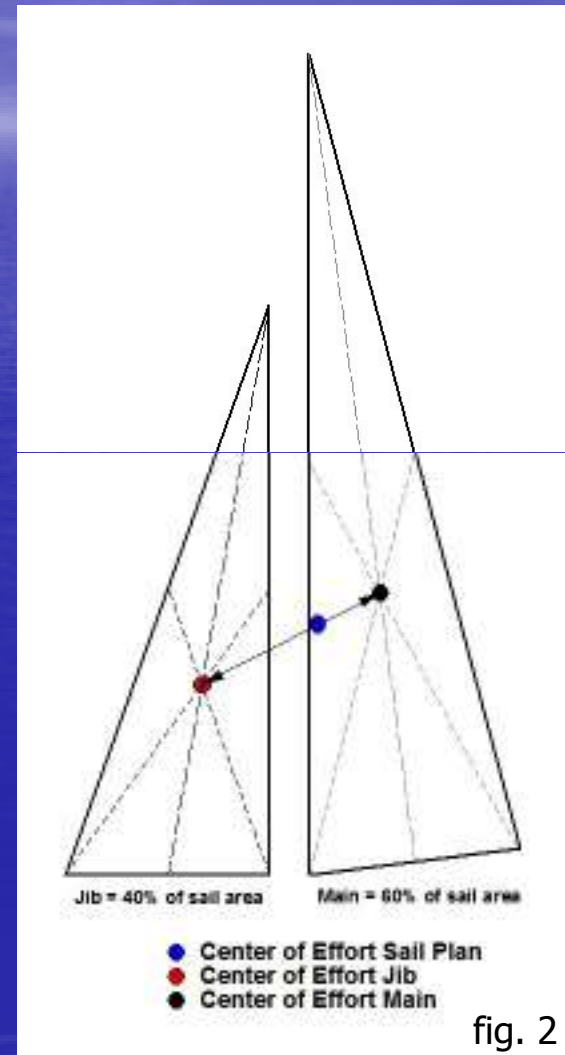


fig. 2

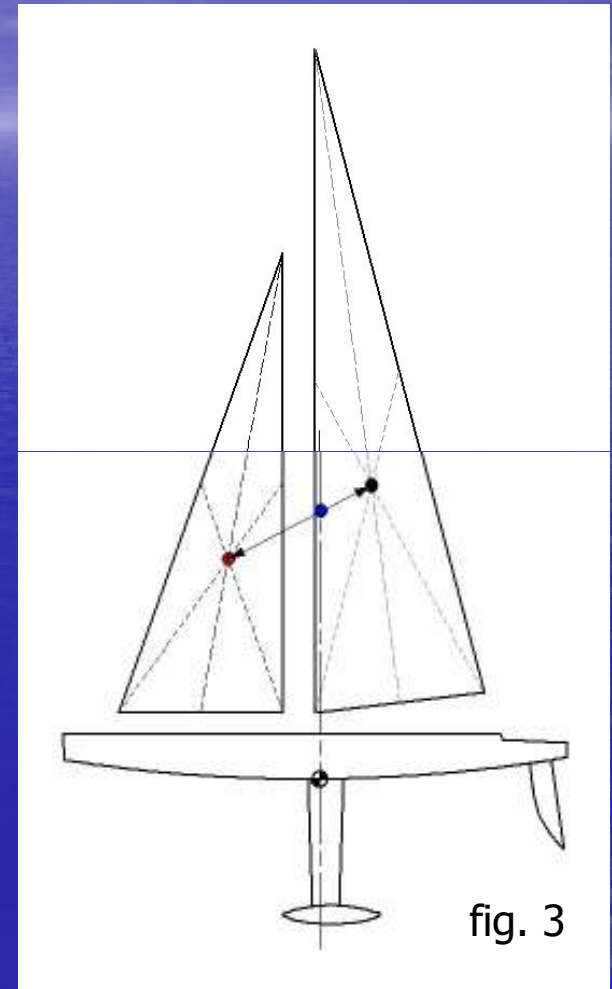
Balance – The Boat

In fig. 3 we see the sail plan and hull together along with their Balance points. In our example you see that the Balance points line-up perfectly. In some boats the sailplan can be slightly ahead of the CLR (lead) or behind (trail).

Because both Balance points are in line, and if the sail trim is equal on the sails, the boat should require little or no rudder input while sailing on a tack in medium wind (say 4-8 kts).

We have omitted the rig (mast, shrouds and stays) to keep it simple, but the assumption is that the mast is centered fore and aft as well as side-to-side.

Once we understand this concept of Balance we can talk about making changes for various conditions.



Adjusting Boat Balance – Rig

In average wind conditions setting the boat up is generally keeping the rig centered and vertical and moderate tension. However, as the wind increases or decreases the boat may not stay in balance and adjustment will be needed.

In general you should in...

Lighter Wind – Rake mast aft

Loosen shrouds, ease backstay, ease forestay, re-tension shrouds and then tighten backstay (you may need to tighten the vang to keep leech tension). *This helps pointing up to the wind*

Heavier Wind – Rake mast forward

Loosen shrouds, ease backstay, tighten forestay, re-tension shrouds and the tighten backstay (you may need to loosen the vang to decrease leech tension). *This helps reduce weather helm (rounding –up to the wind)*

Basic Rig Tuning

Basic set-up (Good for moderate wind, 5-8kts)

- Have mast vertical and centered
- Adjust Shrouds with moderate tension
- Backstay should be "just" tight
- Forestay should be "just" tight

As wind lightens (less than 5 kts)

- Mast can be either vertical or slightly raked aft
- Shrouds can stay the same or slightly more tension
- Slightly loosen back stay
- Slightly loosen forestay

As wind increases (10+ kts)

- Mast can be vertical or slightly forward
- Shrouds can be "just" tight or slightly less
- Backstay can be tightened slightly
- Tighten Forestay slightly



Sail Trim

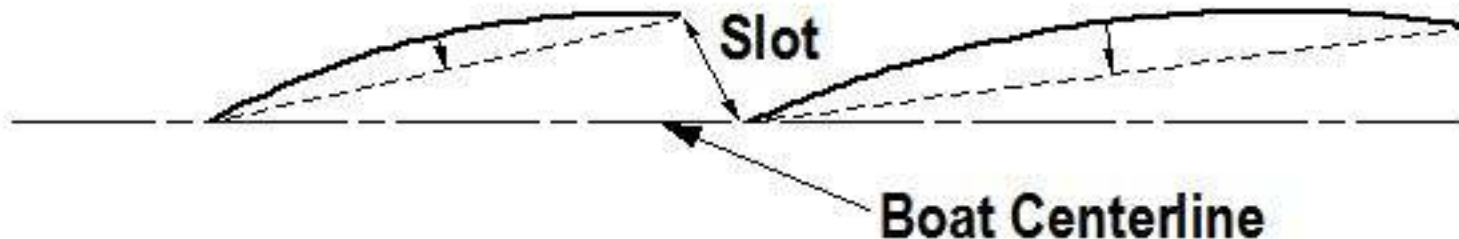
Your sails are the engine that power your boat through the water. This, of course, means they can be considered the most important topic in learning to sail your boat. Again, there are volumes written on the subject and each RC class of boats has there nuisances of sail trim, but our discussion will keep it simple. Once you understand the basics you will have endless hours of trying to maximize you sails for the way that you sail.

We will concentrate on three areas of sail trim:

- Sail Draft
- Leech Tension
- Jib & Main Boom Positioning

Sails – General

In the illustration below we see the basic configuration of sails on a typical RC Boat. Note both the Main and Jib are off the centerline of the boat and the sails have curvature (draft). Controlling both of these aspects of the sails are two of the three most important parts of sail trim. As the Jib and Main booms are independently adjustable they effect the “slot” which is also an important topic in performance



Sails – Draft

The airfoil shape in the shown in "A" is a typical shape for moderate air. In One Meter boats this is typically 1-1¼".

In "B" we see more draft in the sail which would be used for lighter air. Note the draft is increased by moving the clew further in than for the moderate setting.

In "C" we see less draft for super light wind or for increasingly higher winds. In light air the reduced draft allows the air molecules to stay attached to the sail providing lift. In heavy air this setting reduces power in the sail for less heeling.

In "D" we see too much draft. In this case the wind would separate from the sail and pointing would be difficult.

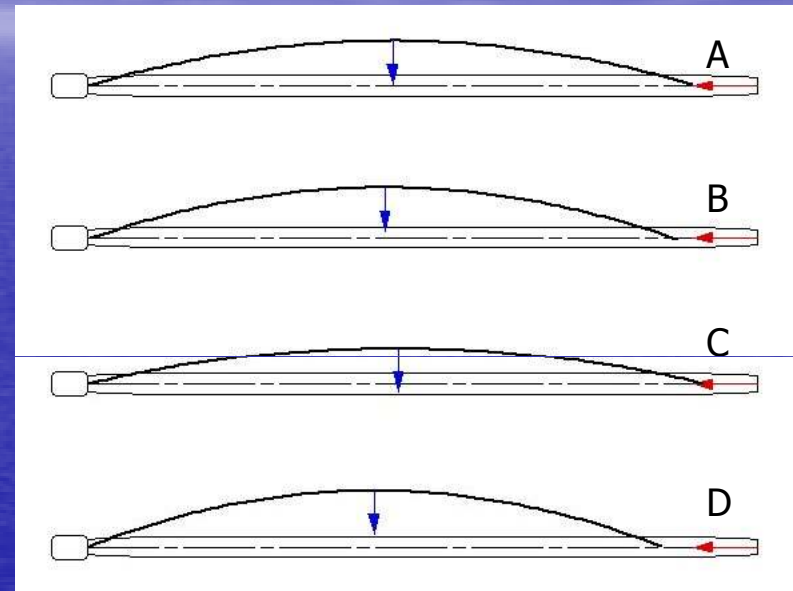




fig. 5


In fig. 5 we see four different draft setting on a mainsail. The blue and red arrows show the draft and clew position under moderate settings.

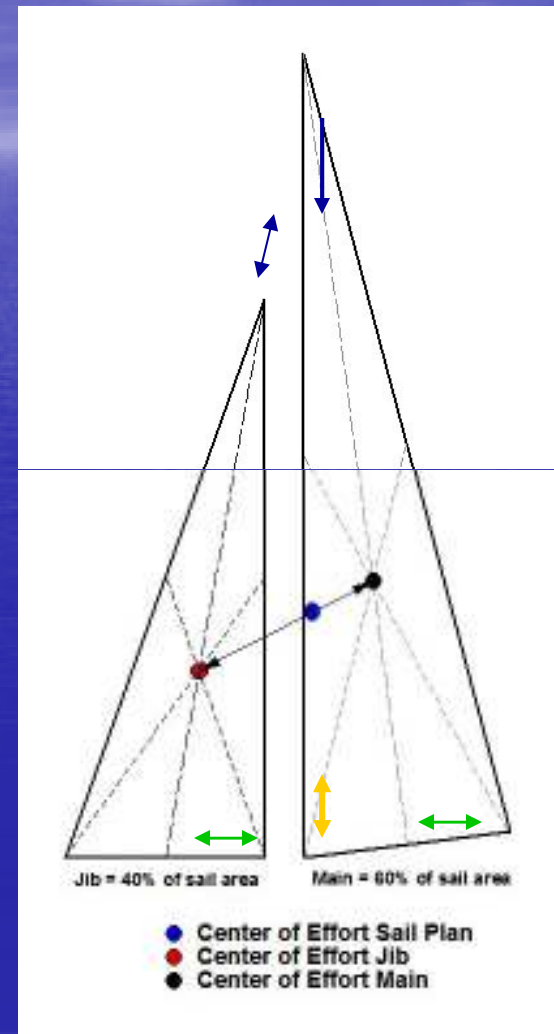
Sails – Draft II

Now that we've seen some of the variations on sail draft (or camber or shape), how do we create the shapes?

The  on the main and jib is the clew in/outhaul. This is the principal tool from changing the draft of a sail.

The  on the main and jib signify the ability of the halyards to apply tension to the luff of the sails and help create a smooth curve.

The  on the main shows the Cunningham or tack adjuster that is seen in some classes. This can allow for luff adjustment and may move the draft slightly fore or aft.



Basic Sail Trim

Basic set-up (Good for moderate, 4-10kts)

- Sails have moderate curvature (draft)
- Vang has moderate tension some leech tension
- Booms should be about 10 degrees off center
- Boat should be balanced requiring little steering input

As wind lightens (less than 2-4 kts)

- Add more curvature to sails
- Booms can be slightly moved toward center
- More tension on Vang (boom lowered) increasing leech tension
- Do not try to steer too high

Very light winds (less than 2 kts)

- Reduce draft in sails to the minimum while having some shape
- Maximum leech tension
- Ease booms out somewhat

As wind increases (10+ kts)

- Start to flatten sails
- Raise boom with Vang top of leech loose
- Booms should be let out



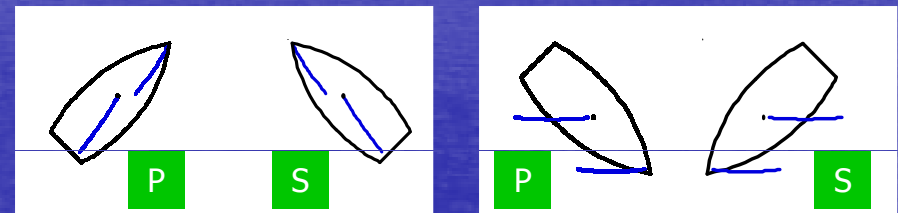
Basic Sailing Rules

The rules of sailing cover all sorts of situations but for the beginner the following rules are a start

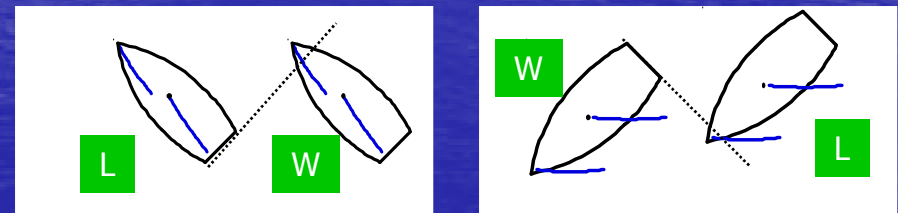
Wind Direction



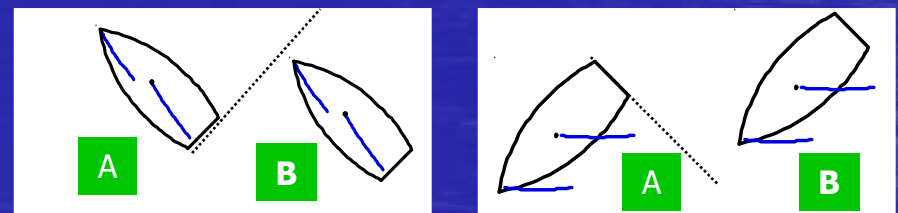
Boats on Opposite Tacks (Gybes)
Port Tack gives way to Starboard Tack



Boats on Same Tacks (Gybes) Overlapped
Windward boat shall keep clear



Boats on Same Tacks (Gybes) Not Overlapped
Boat clear astern (B) shall keep clear of boat clear ahead (A)



The fundamental rules of sailing are Sportsmanship and Fair Sailing

Basic Sailing Rules II

The American Model Yacht Association (AMYA) offer a simplified set of rules for sailing using the SLOOP BOATS formula

S tarboard beats Port

L eeward beats Windward

O vertaking boat keeps clear until Overlap of stern is acquired

O ther boats get room to keep clear when right-of-way acquired

P enalty 360s taken without protest

B ouy room for all inside Overlapped boats

O bstructions – Hail for room to avoid

A ll rights lost when taking penalty 360

T acking – Keep Clear – warn of tacking intent

S ail a proper course

Rules Continued

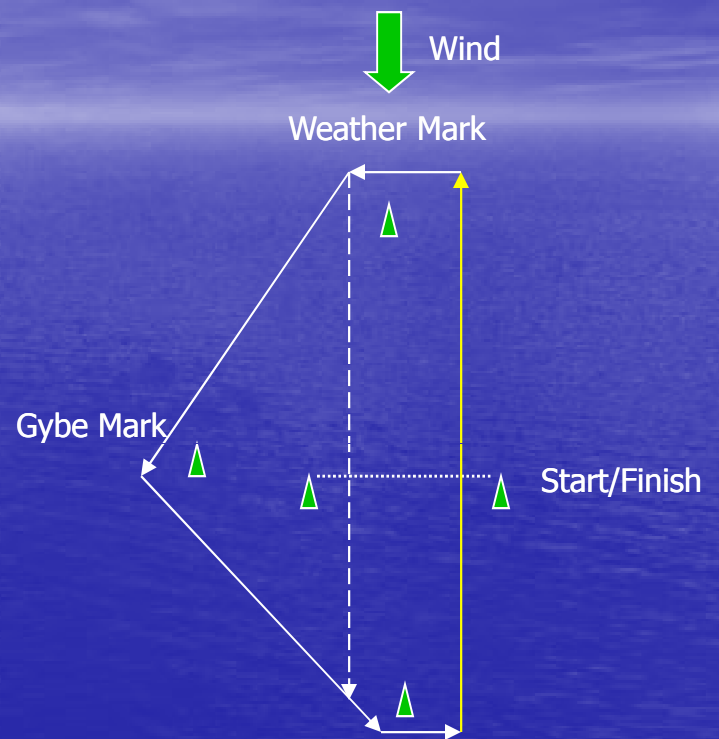
- If you break a rule, good sportsmanship dictates that accept your penalty
- To absolve yourself, you must essentially make a turn that includes at least one tack and one gybe
- The penalty shall be taken at the first opportunity when performing the turn will not hinder other boats
- If you believe that the penalty was called in error you may wait until the end of the race to protest, however, losing a protest generally results in a stiffer penalty

The Race

There are many possible course configurations but the courses shown are most typical. Generally the first leg is set so that the boats sail upwind. Sometimes the course may be twice around.

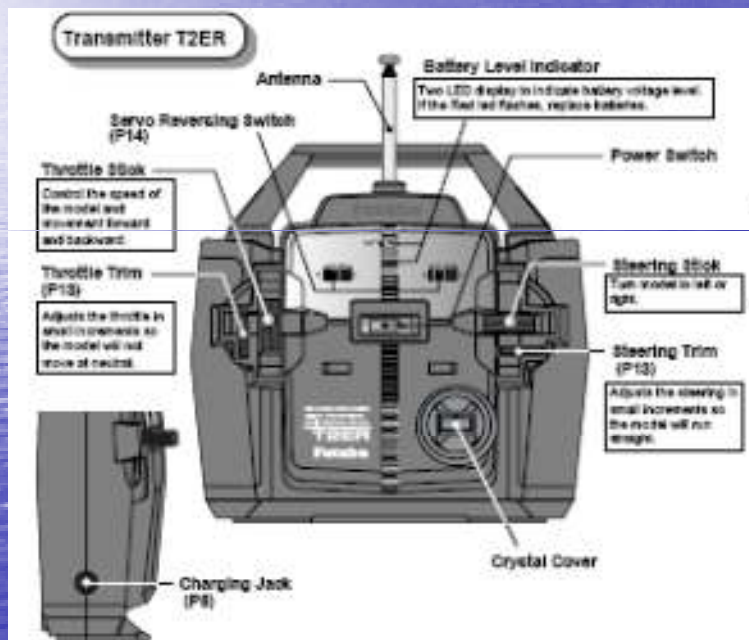
At the start there is usually a one or two minute period called a starting sequence. During that sequence all racing rules apply and you are not allowed to go past the starting line without taking a penalty.

As a general rule, marks should be taken to Port, that is, when you round the mark the mark should be on the Port side of your boat.



The Radio – AM or FM

To maneuver your boat you will need a Transmitter (Radio), Receiver, Two (2) Servos and 12 "AA" Batteries



Typical Transmitter

The typical Transmitter has 8 "AA" batteries that can be the rechargeable type. The Left stick is used for bringing the sails in and out and the right stick moves the rudder. This type of radio is called a 2-channel radio.

The signal from the Transmitter Antenna is picked up by a Receiver on the boat, which sends the inputs to the Sail and Rudder Servos. These devices are powered by a set of 4 "AA" batteries.

Each boat on the water must operate on a different frequency (crystal) when using an a traditional radio. Consult with you local club to see what frequencies are available

The Radio – Spread Spectrum (2.4GHz)

To maneuver your boat you will need a Transmitter, a Receiver, Two (2) Servos and either 4 or 8 "AA" Batteries



2.4 GHz Transmitter

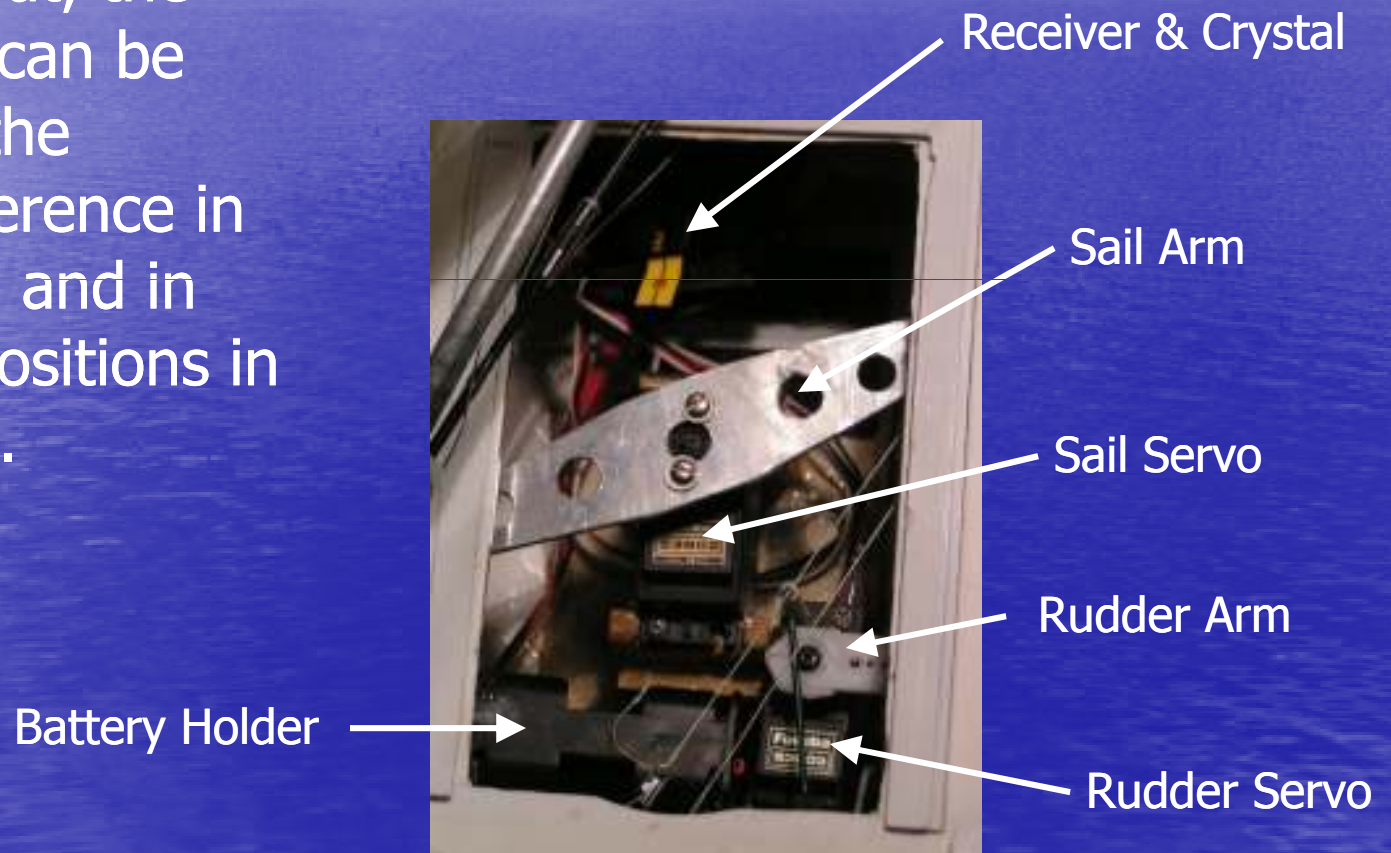
The 2.4GHz Transmitter has either a rechargeable battery pack or uses 4 "AA" batteries that can be the rechargeable type. The Left stick is used for bringing the sails in and out and the right stick moves the rudder.

The signal from the Transmitter Antenna is picked up by a Receiver on the boat, which sends the inputs to the Sail and Rudder Servos. These devices are powered by a set of 4 or 5 "AA" batteries.

The 2.4GHz setup eliminates the frequency problems of AM/FM and offers more customization of controls. While more expensive than older style radios the prices are coming down and it's convenience is worthwhile even for the beginner.

Radio Part II

Inside the boat, the components can be mounted to the builders preference in some classes and in designated positions in other classes.



Which Boat

As of this writing the American Model Yacht Association (AMYA) recognizes 25-30 different boats. Unless you live in an area that has a pocket of a certain boat, it is usually wise to select a boat that has a population nearer the top. All of the AMYA boats sail well and there is little variance in sailing skill needed.

Since this presentation is targeted at the newer RC Sailor, while there isn't a really wrong boat, we recommend boats that meet the One Meter Rule. The reasoning is that these boats are low to moderate in cost, are generally easier to assemble and are easy to transport.

Starting smaller with a Micro Magic is also a good idea but does require a bit more building expertise than a SeaWind but less than a Soling.

The other good starting boat is the nominal 12" Footy which is growing in popularity but is usually considered a second boat.

Two boats fit the recommended criteria well

Seawind – Low cost compared to other boats, very easy to assemble, requires no modifications and can be sailed by the beginner or experienced sailor

Soling 1 Meter – Somewhat higher priced than the Seawind, requires more building time and expertise but is a good sailing boat

Good Sailing!



Practice – Practice – Practice!