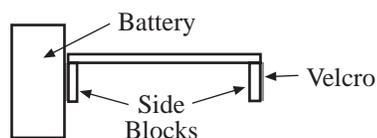
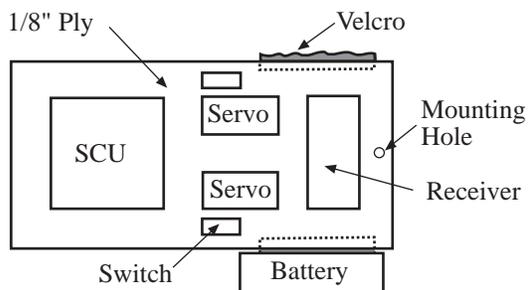
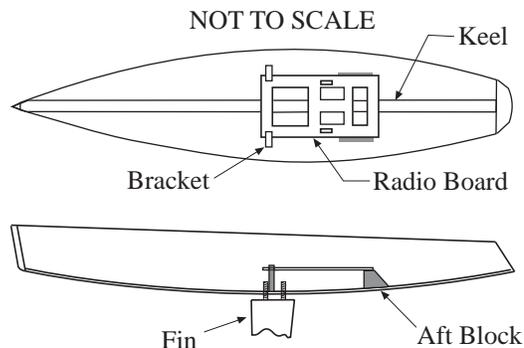


RADIO BOARD

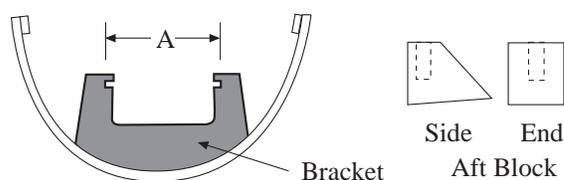


This is a typical radio board. The radio board is often called a sail control unit (SCU) board. Change dimensions, type of components and placement of components to fit your equipment. The radio board is best installed before the deck is applied. Be sure the board can be easily installed and removed through the hatch opening. The radio board is usually made from 1/8" thick plywood (carbon fiber/foam laminate will give more strength with less weight). Cut out openings for sail control unit, servos, switches and receiver. Epoxy or Zap side blocks in place. Velcro (available in sewing supply department of yardage goods store) can be used to mount batteries to side blocks. Use contact cement to glue Velcro strips to batteries and side blocks. Be sure to put a water proof finish on the board.

RADIO BOARD INSTALLATION



Your equipment dictates the size and placement of the radio board.



Make the hull bracket from 1/8" plywood. Cut and sand until bracket fits hull and radio board perfectly. Dimension "A" is the width of the radio board. Trim the inside area of the bracket to provide clearance for SCU motor and/or keel mounting bolts and nuts.

Aft block is made from 3/4" pine scrap. Drill hole in block to accept a screw or stud with wing nut. Epoxy bracket and aft block in place, use radio board to establish correct position for them.

RADIO BOX

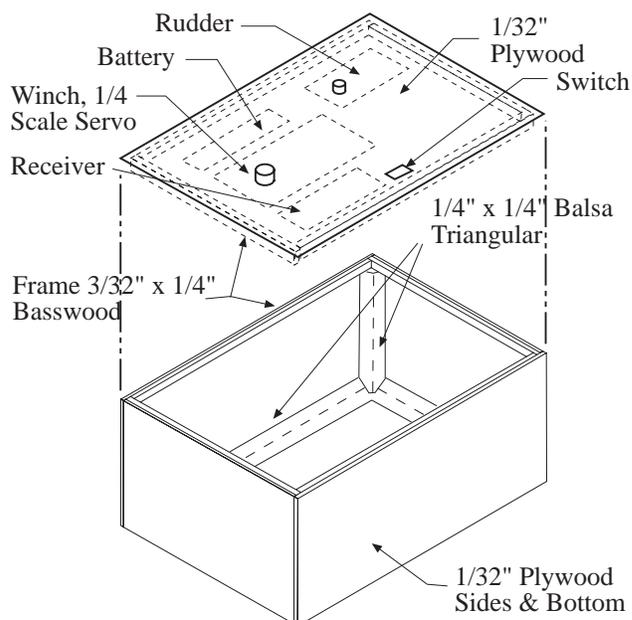
If you sail in saltwater or rough water, the radio box will provide better corrosion protection for your radio gear, than a radio board.

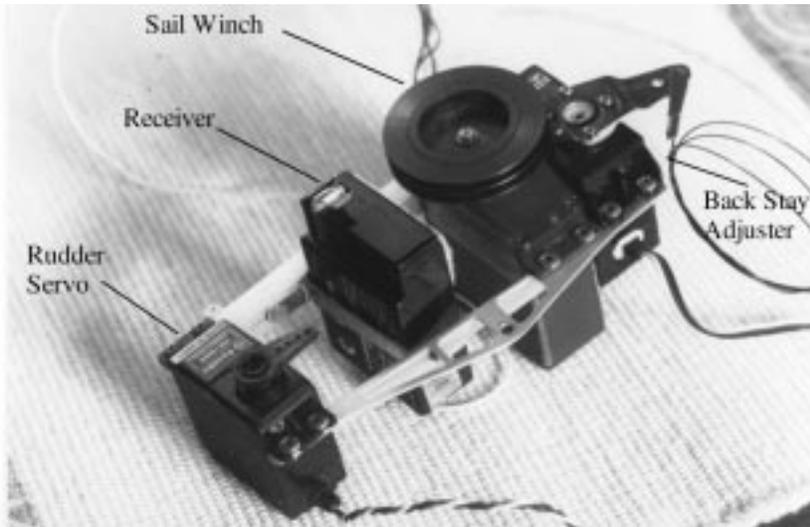
Size the box to fit your equipment. To construct the box, build two frames, the cover frame should be a snug fit inside the box frame. The sides, top and bottom are 1/32" thick aircraft plywood. The box corner joints

are reinforced with 1/4" balsa triangular stock. The whole thing is glued with Zap. The cover slips into the box frame, and can be held in place with a couple of short pieces of tape.

Mount your servos to the cover, with servo rail blocks. Mount the radio switch with a Du-Bro switch mount.

Water proof the box inside and out with Thompson's water seal.





Not all radio boards are wood. This one is made from a couple of aluminum angle irons that are mounted in the hull with simple brackets hung from the centerboard trunk.

RADIO BOXES AND BOARDS

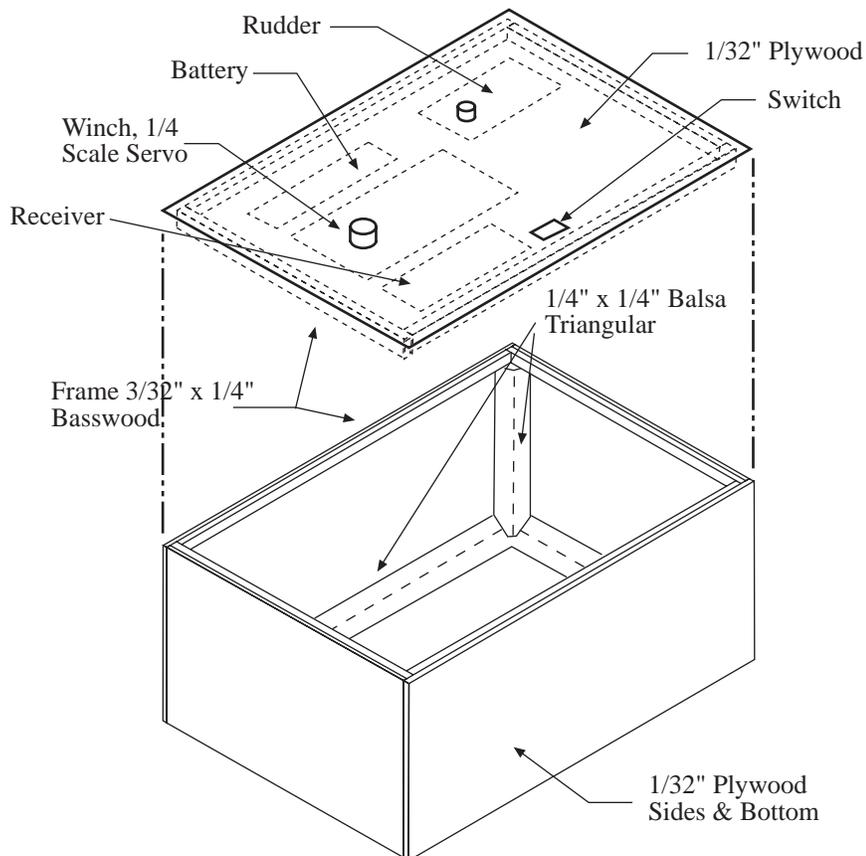
If you sail in saltwater or rough water, the radio box will provide better corrosion protection for your radio gear, than a radio board.

Size the box to fit your equipment. To construct the box, build two frames, the cover frame should be a snug fit inside the box frame. The sides, top and bottom are 1/32" thick aircraft plywood. The box corner joints

are reinforced with 1/4" balsa triangular stock. The whole thing is glued with Zap. The cover slips into the box frame, and can be held in place with a couple of short pieces of tape.

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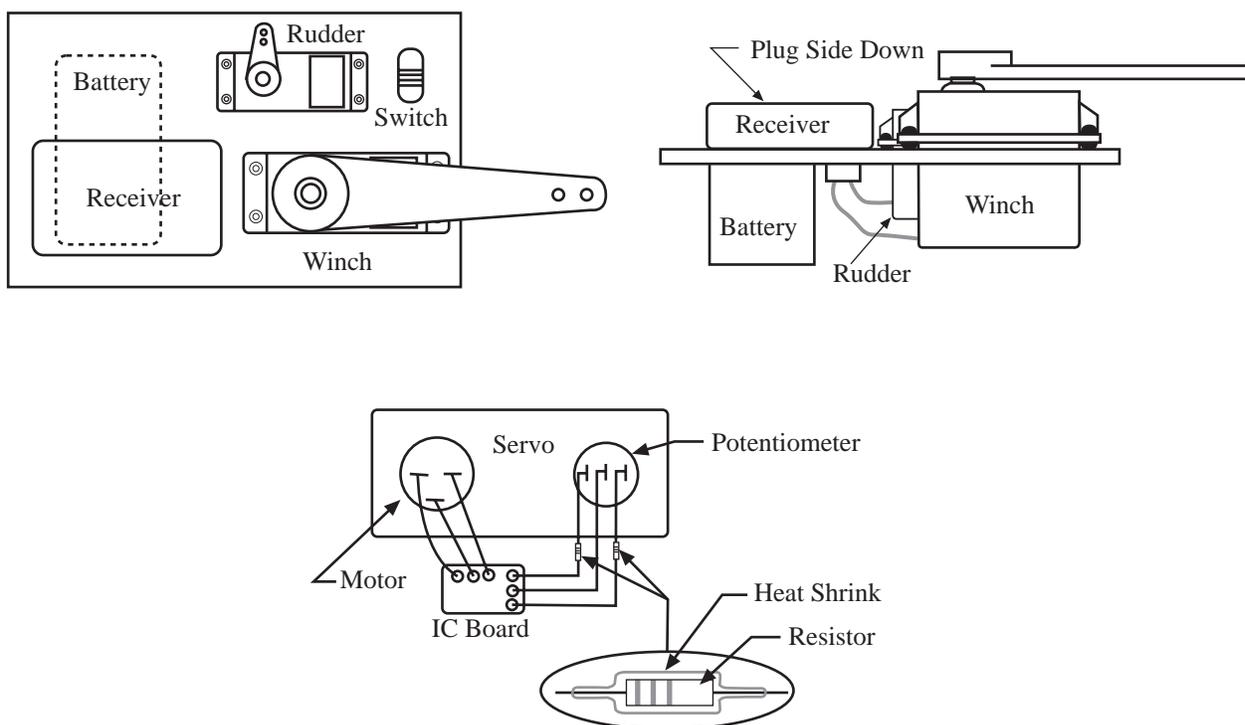
PROPORTIONAL WINCH LAYOUT

The sail control servo is a model airplane 1/4 scale servo, and has about 165 in oz of torque. Which is enough torque to operate both sails for a One Meter.

The winch should have 160 to 170 degrees of rotational throw. If it has less than 160 degrees of throw you need to add the resistors to the potentiometer. Add a resistor in series to each of the outside wires from the IC board to the potentiometer. No resistor is added to

the center (wiper) connection. Cover the resistors and solder connections with heat-shrink tubing. The resistor value is 1K to 2.2K ohm, depending on rotation required. Increased resistance = Increased rotation.

Mount the rudder servo from the under side of the radioboard, to provide clearance of sail winch arm over the rudder servo. If this is not enough clearance add spacers between sail winch mounting lug and radioboard.



SERCO CONNECTORS

You can mix and match Futaba, Airtronics, Hitec and JR electronics equipment. All you need to do is to make sure the polarities of the power wires match. For Futaba, Hitec, and JR Radio equipment, the servo and battery connections have the same power polarity and signal wires. The plastic connectors are physically different, but if you're creative, you can get all of those brands to fit each other. Simply cut off the tab on a Futaba connector and it will fit in a Hitec or Airtronics receiver. You can cut off the "teeth" on an Airtronics connector to get it to fit in other brands.

The power wires of Airtronics equipment have different polarities than the other brands, so you need to switch the wires around before you can use Airtronics equipment with other brands. If you want to switch the wires around, the plastic connectors have little tabs or pins you can push or lift with a straight pin to free the wire for removal. It's easy to push them back into the connector in the right order.

For the last couple years, Airtronics has been selling servos with an optional "Z" connector that matches the polarities of JR Radio and Hitec servos. With one of these "Z" connectors, you won't have to switch (+) and (-) wires to use an Airtronic servo with Futaba, Hitec, or JR receiver.

Below are the four standard connectors that are used by the "big four" radio manufacturers.

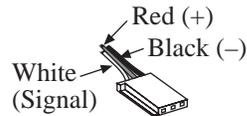


Figure 1. The Futaba "J" connector. The tab can be cut off so a Futaba connector will fit other systems.

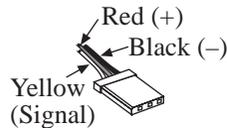


Figure 2. The Hitec connector. Except for the color of the wires this connector is identical to the one used by JR.

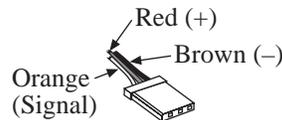


Figure 3. The JR Radio connector. For all practical purposes it is identical to the Hitec connector.

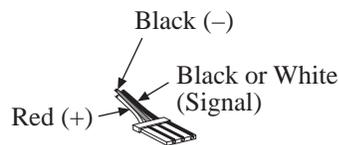


Figure 4. The Airtronics connector. Note that (+) and (-) are reversed from Futaba, Hitec, and JR connectors.

CONVERTING A 90° WINCH TO 180° OPERATION

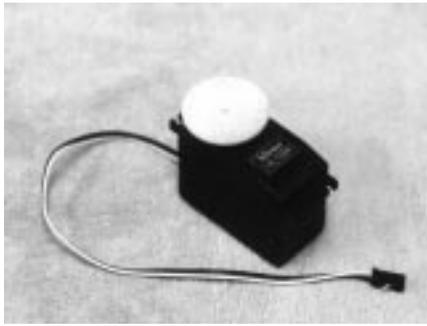


Figure 1. The Hitec RCD 715 BB.

Because it seems to be getting harder and harder to find a suitable arm winch for one meter boats without spending a pile of dough, a lot of people have asked how to convert one of the less expensive 1/4 scale aircraft servos from 90 degree rotation to 180 degrees. The answer is that it's simple if you choose the right servo.

While I make no claim that the following method will work for all servos, I have used it on a number of different brands with success. Basically, the principle is to increase the resistance of each leg of the trimmer potentiometer (hereafter referred to

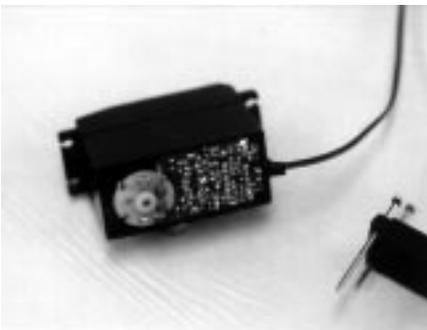


Figure 2. In this photo the motor is to the left and the integrated circuit board is to the right of the case.

simply as a *pot*); the higher the resistance, the more the rotation. The rule-of-thumb is that increasing the resistance of each leg of the pot approximately 2,000 ohms will give the desired 180 degrees of rotation.

The easiest way to do this is to open the servo case, cut the wires to the legs of the pot (not the wiper, which is almost always the centerpost), solder in a couple of 1/4 watt fixed resistors and put it all back together.

Of course there are a number of different servo configurations, and this modification is easier to make on some servos than others. For this example I'll use a Hitec HS-715BB which is by far the easi-

est to work with. Converted to 180° operation, the 715BB makes an excellent sail winch. It weighs 3.6 ounces, and has 189 oz-in of torque at 6 volts (161 oz-in at 4.8 V), and that's plenty of power for most one meter yachts (including the S1m and US1m). Not bad when you consider that you can buy the 715BB from Tower Hobbies for \$50 while a comparable Futaba 3801 costs \$90, and actually rotates less than 140°. By the way, a package of five 2.2 K-ohm resistors is 49 cents at Radio Shack (Part # 271-1325), so I guess the converted

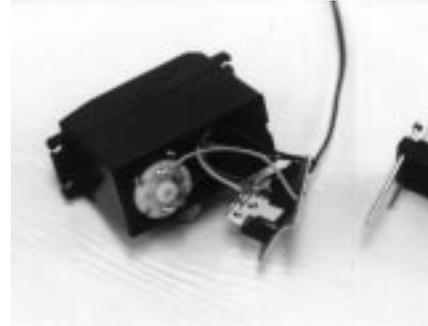


Figure 3. Using a small screwdriver, gently pry the integrated circuit board out of the case.

winch really costs \$50.25. Once your soldering iron has warmed up, you should be able to do the job in ten minutes.

Please don't misunderstand, the Futaba is a fine winch, but if you're willing to spend ten minutes to save \$40, here's the way to do it.

1. Buy a Hitec HS-715BB servo (Figure 1).

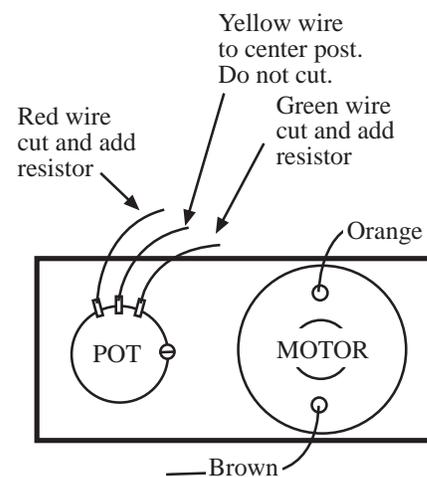


Figure 4. Location of wires. Colors may vary, but location is consistent.



Figure 5. In this photo the two 2.2 k-ohm resistors have been soldered in place.

2. Remove the bottom (Figure 2).
3. Carefully pull out the printed circuit board (Figure 3). Inside you will see a motor and a pot. The pot is deep inside the case. It has three wires soldered to it. (Figure 4)
4. Note the color coding of the three wires soldered to the pot. They may vary, but on mine, the centerpost wire was yellow and the outside post wires were red and green (Figure 4).
5. Cut one of the wires that go to the pot's outside posts, strip the cut ends and solder a 1/4 watt 2.2 k-ohm resistor between the two cut ends.
6. Repeat step 5 for the wire that goes to the pot's other outside post (Figure 5)
7. Tape the new connections to insulate and avoid shorting
8. Carefully push the new resistors up inside the servo case and reassemble the unit using the supplied sail winch arm (Figure 6).

That's all there is to it. Other servos have different layouts, but the principle is the same.

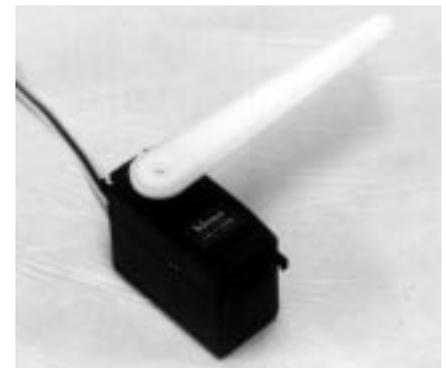
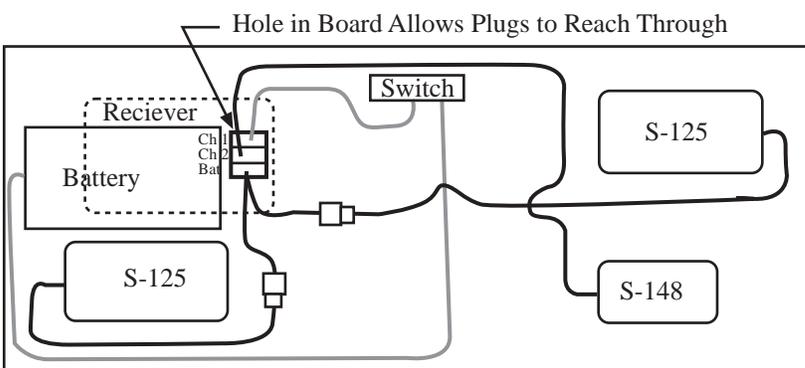
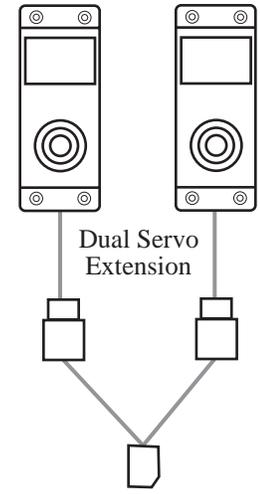
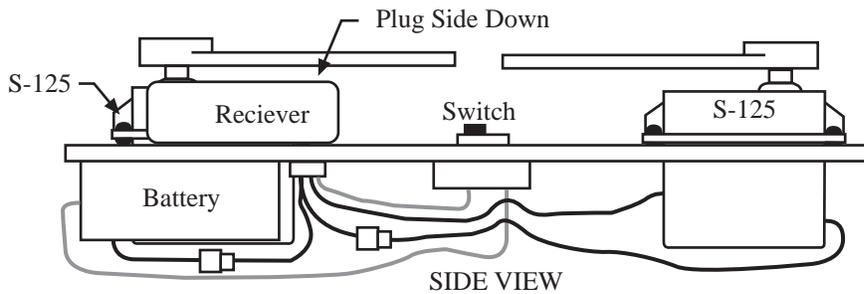
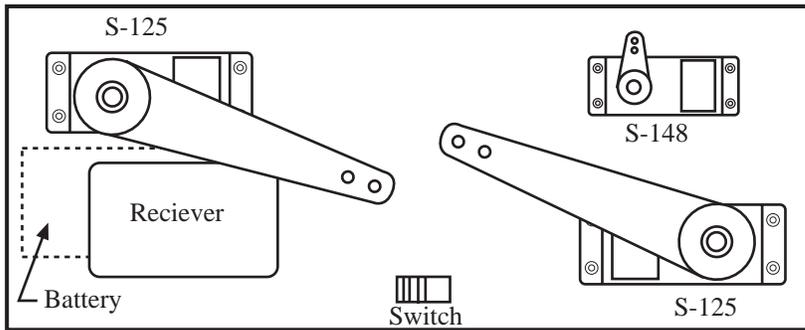


Figure 6. Insulate the new connections before stuffing everything back into the servo case. I use electrical tape.

RADIOBOARD WITH 2 S-125'S AND 2 CHANNEL RECEIVER

This arrangement gives proportional control, with two S-125 arm type sail winches and two channel receiver. The two S-125 servos are connected together with a dual servo extension (available from hobby shop), and

plugged into the receiver channel controlled by the left transmitter stick. You do not have independent sail trim with this arrangement. The S-148 servo is used for rudder control.



CONVERTING A FUTABA S148 TO A DRUM WINCH

By Scott Vernon,

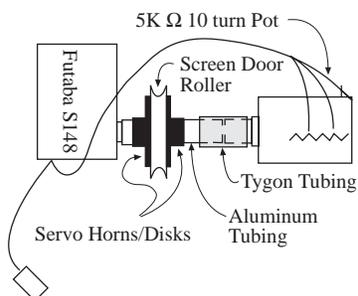
With thanks to Charles Baltzer.

This is a very easy to build sailwinch, probably easier than any other homemade proportional sailwinch. I have found it strong enough to trim both main and jib on a US One Meter in most any wind. Mine turns about 2-3/4 revolutions with full stick travel. The nice thing about it, besides being cheap, is that you control it like any other winch. Push the transmitter stick up. The winch spins and stops.

What you will end up with is a 4 inch wide sailwinch. The S148 will be on the left, drum in the center, and 10k pot on the right - all joined together on a centerline. This is shown in the sketch.

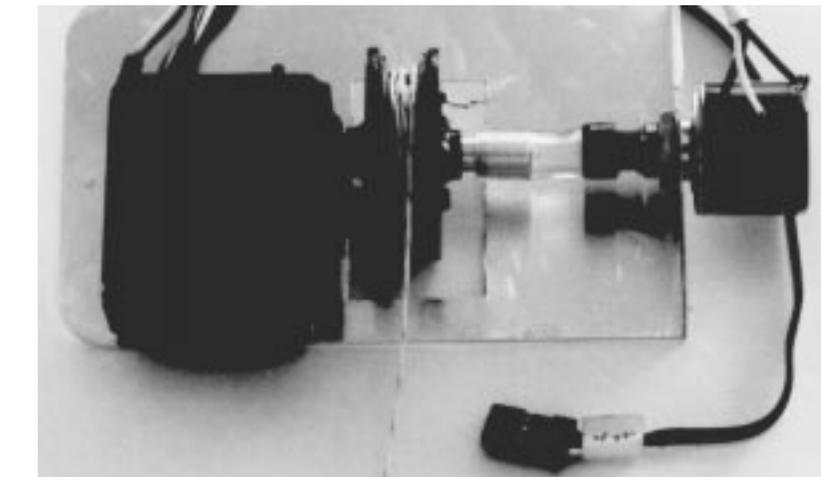
Materials - Futaba S-148 Servo, 8 inches of 3 color wire, Spectrol precision 5 K 10 turn pot from Newark Electronics Stock no. 44F1105R5.0K, Type 536-1-1-502, 1/4 inch dia aluminum tube 1 inch long, 1/4 i.d.tygon or surgical tubing 5/8 inch long, 2 servo horns/disks, nylon sliding screen door roller (It is about 1 inch diameter and about 3/4 inch diameter at the bottom of the groove - 2 in a package with little clips attached), radio board. Soldering is required.

Make the servo turn 360 degrees: Re-



move the 4 long screws. Take the case apart by separating the output side of the case from the rest. No arm should be attached to the output shaft. Take all of the gears out, remembering how to put them back. You will see that the output "gear" has a stop molded into it. File off the stop so the servo can turn 360 degrees.

Pop off the metal ring under the output gear. Remove the two tiny screws. Remove the bottom cover exposing the circuit board. Push a little on the gold



shaft and carefully pry on the corners to remove the circuit board.

Cut the three stiff silver wires running to the pot. Remove and discard the pot. Solder the 3 color wires to the servo side of the silver wires. The colored wires will run out of the case and over to the new pot. Note which color goes to the center (wiper) pole on the old pot. Write it down. You need to break a little bigger opening in the plastic case with needle nose pliers where the existing wires exit the case. You might want to seal that hole when you are finished. Reassemble the servo: Circuit board, metal ring, 2 little screws, gears, case.

Make a drum. The easiest drum is made from a sliding screen door nylon roller sandwiched between two servo horns/disks. Bolt/screw them together. When you drill across the roller make sure you do not penetrate where the line will wrap. Other larger drums may be more desirable. Use your imagination - maybe part of the neck of a plastic pop bottle, maybe a servo disk sanded flat and CAed in a sandwich between 2 bigger servo disks (That is tricky). The main concern on any drum is that you end up with a servo horn/disk on each side of the drum with the spline sides pointing out.

Take the drum assembly and slip it onto the servo. Screw it in place using the standard little black servo screw. Take the alu-

minum tube and force it into the splined holed in the other side of the drum. Slip the flexible tubing over the aluminum tube. Slip the other end of the flexible tubing onto the pot.

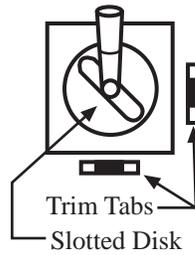
Attach the servo and pot to a radio board, mounting the servo on its side. Clip the wires to the poles on the new pot. The wires must be long enough to arc out of the way of the sheets on the drum. The wiper wire that you carefully noted above must go to the wiper pole on the new pot. There is a diagram on the new pot. It shows 2 poles on the ends of a jagged line. The other pole is the wiper. Hook the servo up to your receiver and try it out. If the servo burns up you hooked the wiper wire to the wrong pole. If it is uncontrollable switch the other 2 wires - leave the wiper wire hooked to the wiper pole. When you are satisfied that it works properly, solder the connections to the new pot. You may find that the tygon slips on the shaft, so you may have to wire/squeeze it somehow. A little forced slipping makes it possible to adjust the drum - a good thing.

I like to run the sheets out of the boat at the transom. This allows me to have the elastic on deck - it is necessary to keep the line wrapped around the drum taut with elastic as with any sailwinch and it is good to release the tension when the boat is not being used.

RADIOBOARD WITH 2 S-125'S AND 4 CHANNEL RECEIVER

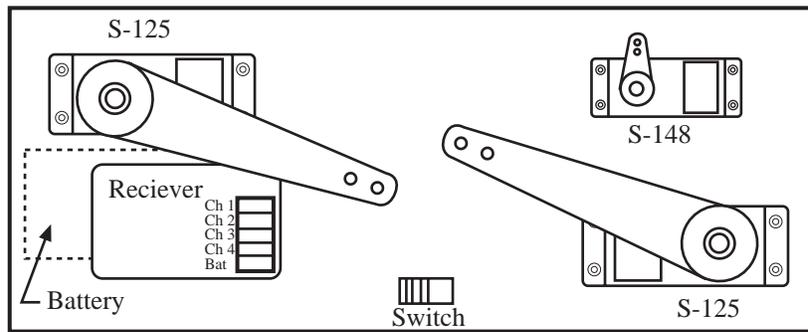
This arrangement gives proportional sail control, with two S-125 arm type sail winches and four channel receiver. And independent sail trim.

The transmitter left stick will need to be modified. Modify the left stick by removing both tensioning springs, and placing a plastic disk with slot over the outside of the

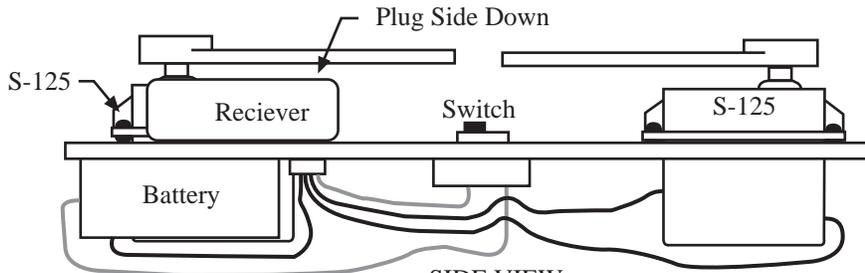


left gimbal. This limits stick travel diagonally. The two trim tabs will allow independent fine trim of each sail.

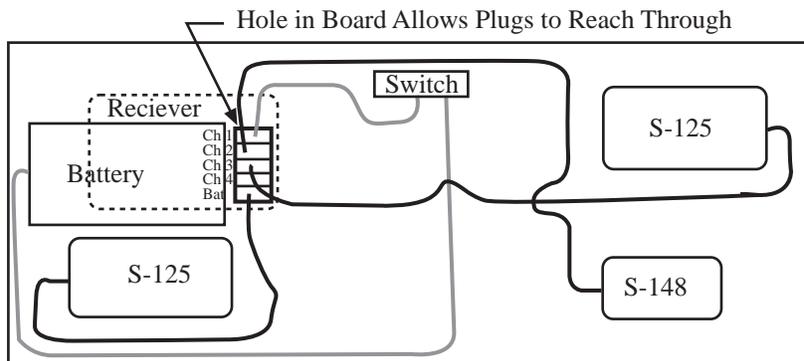
Plug the two S-125 servos into two channels in the receiver that are controlled by the left transmitter stick. The S-148 servo is used for rudder control.



TOP VIEW



SIDE VIEW



BOTTOM VIEW

CONVERTING THE FUTABA S3801 TO 180 DEGREES ROTATION

By Rich Dannenhoffer, Space Coast Model Yacht Club

The Futaba S3801 servo is a popular choice for 1 Meter size boats. It's compact, strong, fast, waterproof and plugs right into the Futaba radios many sailors use. Unfortunately, despite being labeled a sail servo, it only has 90 degrees of travel. I purchased one for my Soling 1M several years ago and, after some research, promptly tore it apart and modified it for 180 degrees of travel. After modifying a half dozen or so I've finally gotten around to documenting how to do it so here goes.

The modification involves putting two 10k Ω micro trimmer potentiometers in the servo feedback circuit. The feedback potentiometer is located under the output shaft and tells the circuit how far the shaft has turned.



Figure 1. The tools required to make this conversion should be in every model maker's tool box.

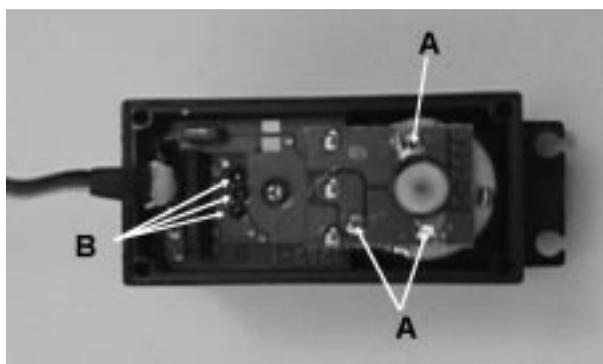


Figure 2. Open the servo case being careful not to damage the O-ring seal. You'll see two printed circuit boards connected by three (3) jumper wires. Remove the screw holding the PC board labeled S202-1 and desolder the three connections to the motor on the board labeled S202-2, marked A.

I use trimmer pots instead of a fixed resistor because, from what I've been able to find out, the value resistor required is an oddball size. I've also found that once setup the servo will have a slightly different total throw depending on which radio it's connected to. The travel on mine is different for my Futaba 4 channel Conquest than it is for my 2 channel Attack. The trimmer pots give you the ability to fine tune the servo for the particular radio you are using.

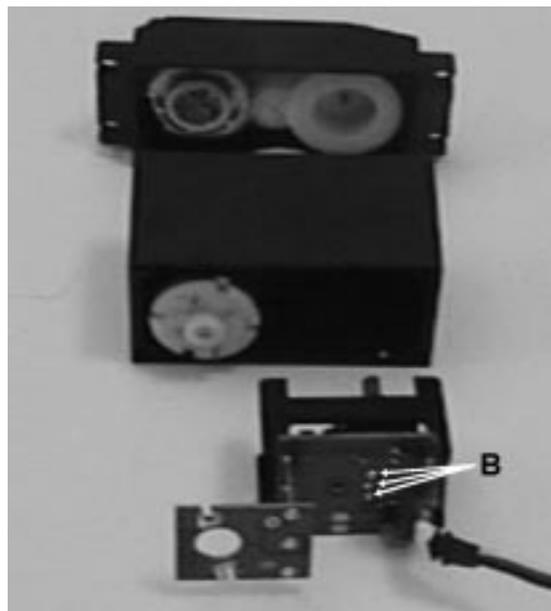


Figure 3. Remove the top of the servo case, keeping the gears in order in the top cover. Remove the small white plastic key under the output gear and gently push down on the brass shaft of the feedback potentiometer to remove both printed circuit boards, see figure 3. Now desolder the three leads (B) from the feedback pot to the S202-1 circuit board and remove the pot and plastic holder.

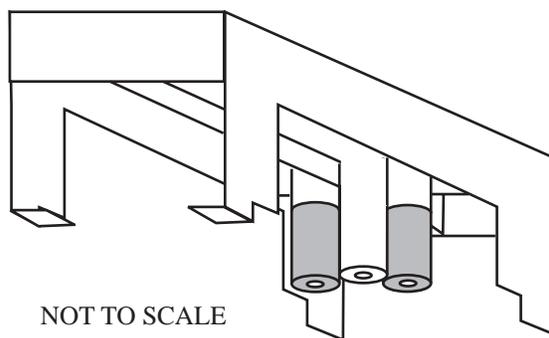


Figure 4. Modify the plastic holder by cutting away the shaded part of the outside two tubes.

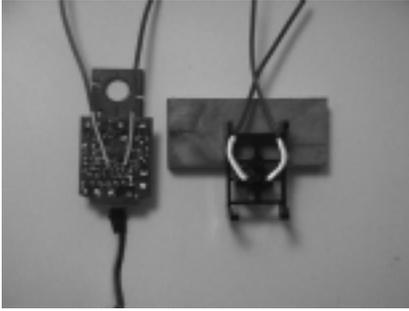


Figure 5. Slide the feedback pot back into the holder and bend the outside leads over as shown. Cut four pieces of thin wire and solder two to the bent over leads. Insulate the connections with heat shrink tubing. Solder the other two wires in the outside holes in the pc board vacated by the bent over leads.



Figure 6. Replace the plastic holder on the circuit board and resolder the center lead of the feedback pot to the pc board. Slide this assembly back into the case routing the wire pairs around the edge of pc board S202-1.

You're going to need a desoldering iron for this job. This is an iron with a hollow tip connected to a rubber bulb to vacume away molten solder, like the one shown at the far left of figure 1. One should be available from any electronics shop for about \$10.00.

This is where I get a little carried away. At this point I etch a third circuit board to hold the micro trimmer pots and fabricate a bracket from Plastruct channel that mounts the board using the existing mounting screw, figure 7. The wires attach to the bottom holes and the other holes are located to mount the trimmer pots you are using. I've never had to reopen the servo so for those who don't want to go through all this effort mounting the trimmer pots to a piece of thin plywood or plastic and then soldering the wires to the pot leads will

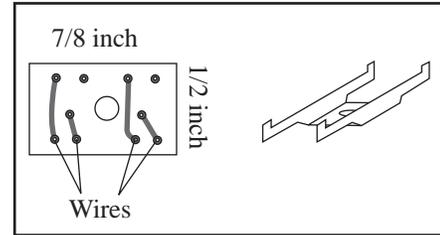


Figure 7. Layout for the new circuitboard and plastic holder to hold the trimmer pots. The author notes that a simple piece of thin plywood or plastic will also work.

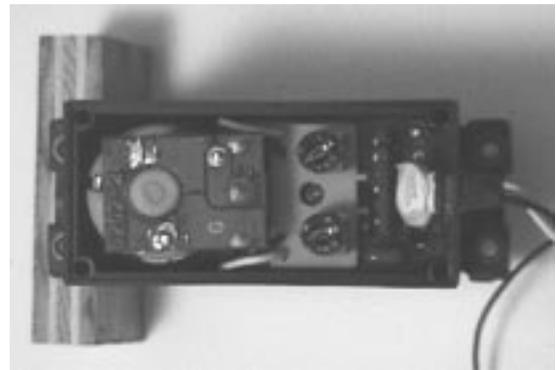


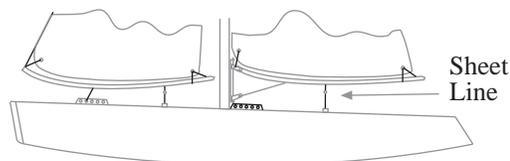
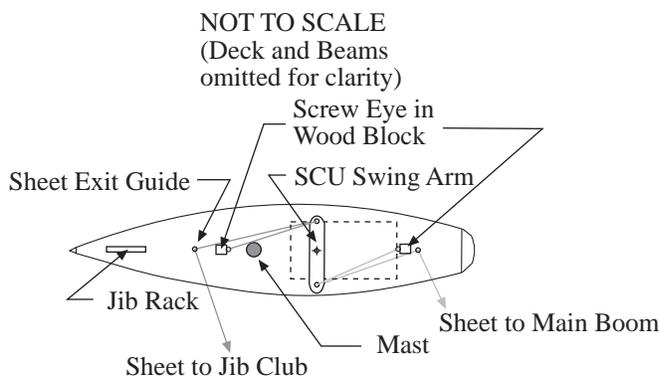
Figure 8. This is what it should look like before reinstalling the bottom cover.

work just as well. This mounting board can then be glued on top of pc board S202-1 using a glob of caulking or glue, just make sure the pot leads don't touch the board underneath. Whatever method you use the end result should look similar to figure 8.

To setup the modified servo first set the trimmer pots to zero. Now reinstall the gears and case top taking extra cares to align the feedback pot shaft and output gear properly. Put the servo arm onto the output shaft and hook the servo to you're radio. Holding the top on the servo turn each trimmer pot about an eighth of a turn and cycle the servo from stop to stop. Gradually turn the trimmer pots in small increments until you achieve the desired travel. Unplug the servo and install the bottom cover.

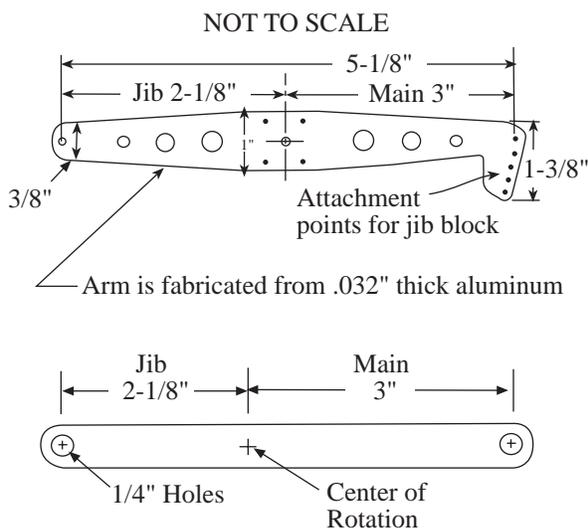
ARM WINCH SETUP SCU AND SHEETING

This Sail Control Unit (SCU) sheeting arrangement uses double purchase on both jib and main. A small screw eye in a block of wood is epoxied under the kingplank in the position shown. A small fishing tackle swivel and snap fastener can be used to attach sheet to screw eye.



Tape sheets to framework temporarily to get correct sheet length.

The ideal sheet attachment point on the jib club and main boom is directly above the sheet exit guide.



The SCU arm dimensions given are approximate. Your equipment dictates size and placement.

Suggestion: Use scrap wood to make a test SCU arm to insure proper arm and sheet length. When you are satisfied the test arm is correct, use it as a template to make the plastic or aluminum arm.

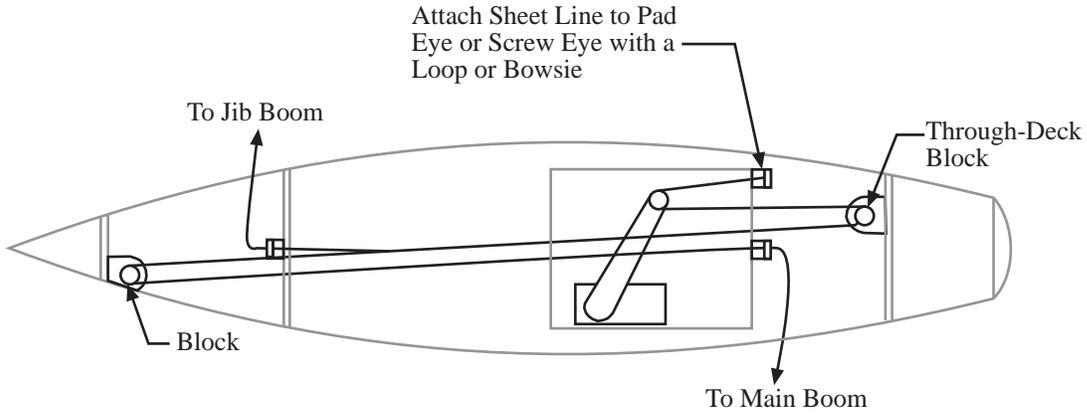
Determining Winch Arm Length

(From MY #66, Credited to Don Prough of Probar Design)

1. Connect the sheet line to the boom in the manner you plan to use while sailing.
2. Run the line into the boat through the fairlead.
3. Hold the boom in the "full in" position, and make a mark on the sheet line at the point where it enters the fairlead. Obviously, the line should be taut, and four hands are better than two!
4. Hold the boom in the "full out" position and make a mark on the sheet line as before.
5. Measure the distance between the two marks and:
 - a. For a single purchase arrangement, divide the distance by two, This is the length of the winch arm from the center of your winch's output shaft to the center of hole in the arm though which the sheet line will pass.
 - b. For a double-purchase arrangement, divide the distance by four and add 1/4 inch to the result. This is the length of the winch arm from the center of your winch's output shaft to the center of hole in the arm though which the sheet line will pass.
6. Repeat the process for the arm for the other sail.

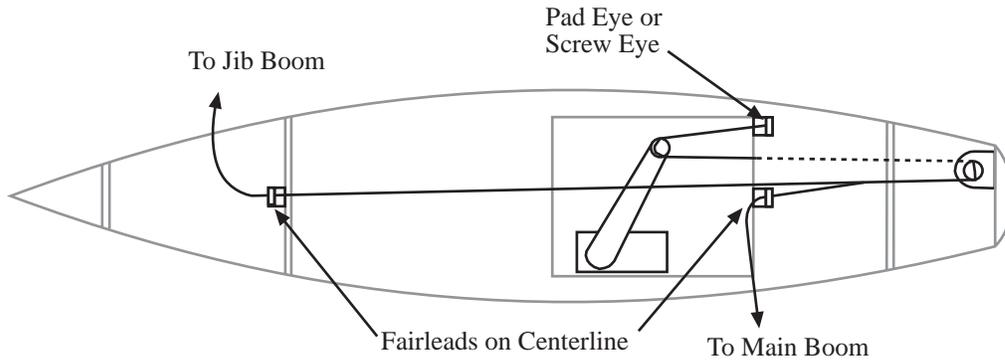
SINGLE ARM WINCH SHEETING

This sheeting arrangement is for narrow hulls with limited access in stern. Most of the sheeting is above deck, by use of "Through Deck Blocks."



SINGLE ARM WINCH SHEETING

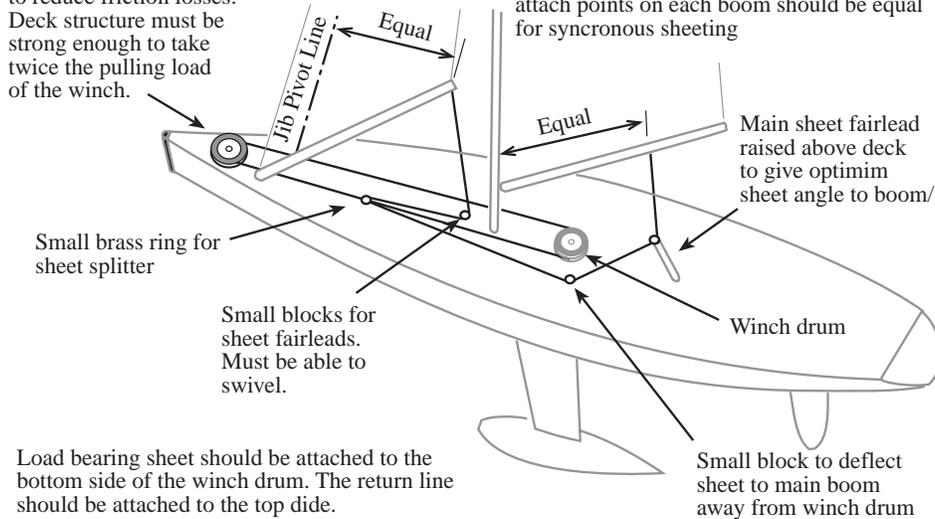
This is another arrangement for single arm sheeting, which can be used in wide hulls with easy access in the stern. It also has most of the sheeting above deck.



DRUM WINCH SHEETING

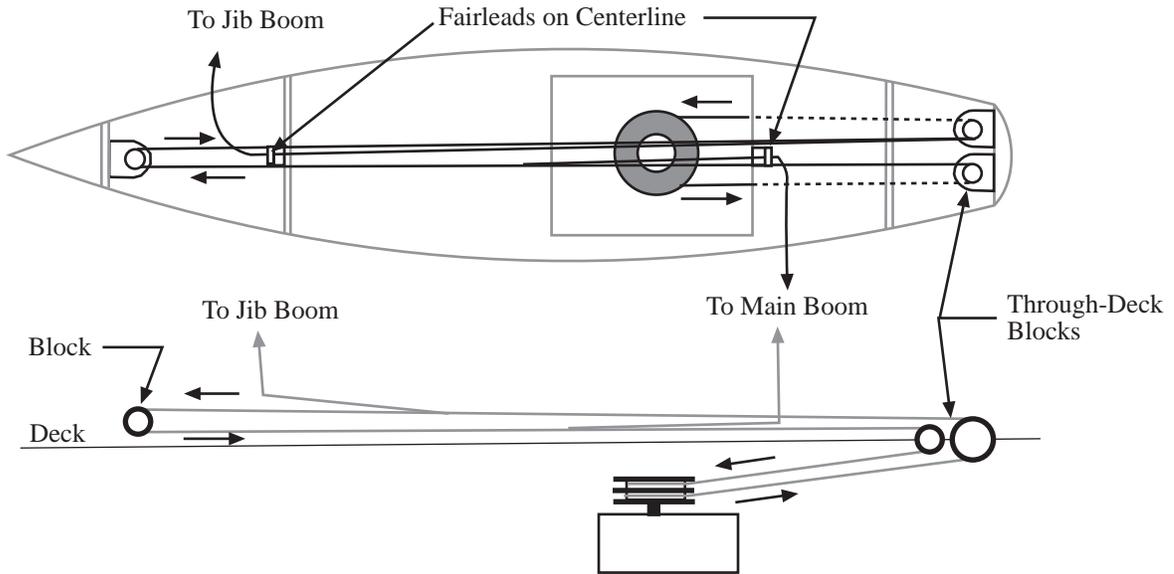
Use large diameter bow return pulley to reduce friction losses. Deck structure must be strong enough to take twice the pulling load of the winch.

Distance from the line of pivot to the sheet attach points on each boom should be equal for synchronous sheeting

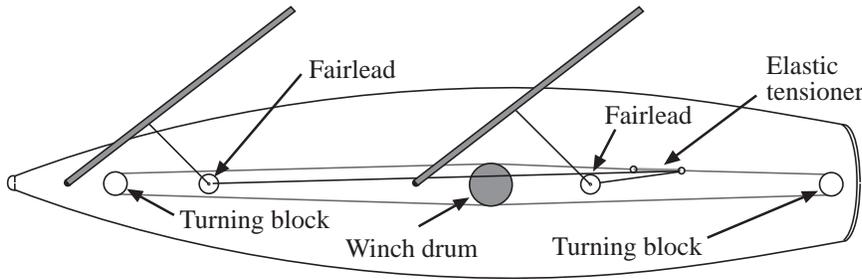


DRUM WINCH SETUP

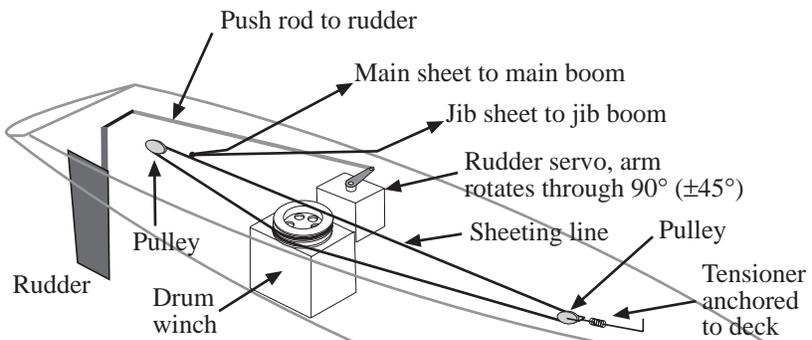
This arrangement for a Drum Winch has “Continuous Loop” sheeting, for narrow hulls with limited access. Most of the sheeting is above deck



Note: The side view drawing shows the “Through Deck Blocks” as different sizes, they are not, they are both the same size.



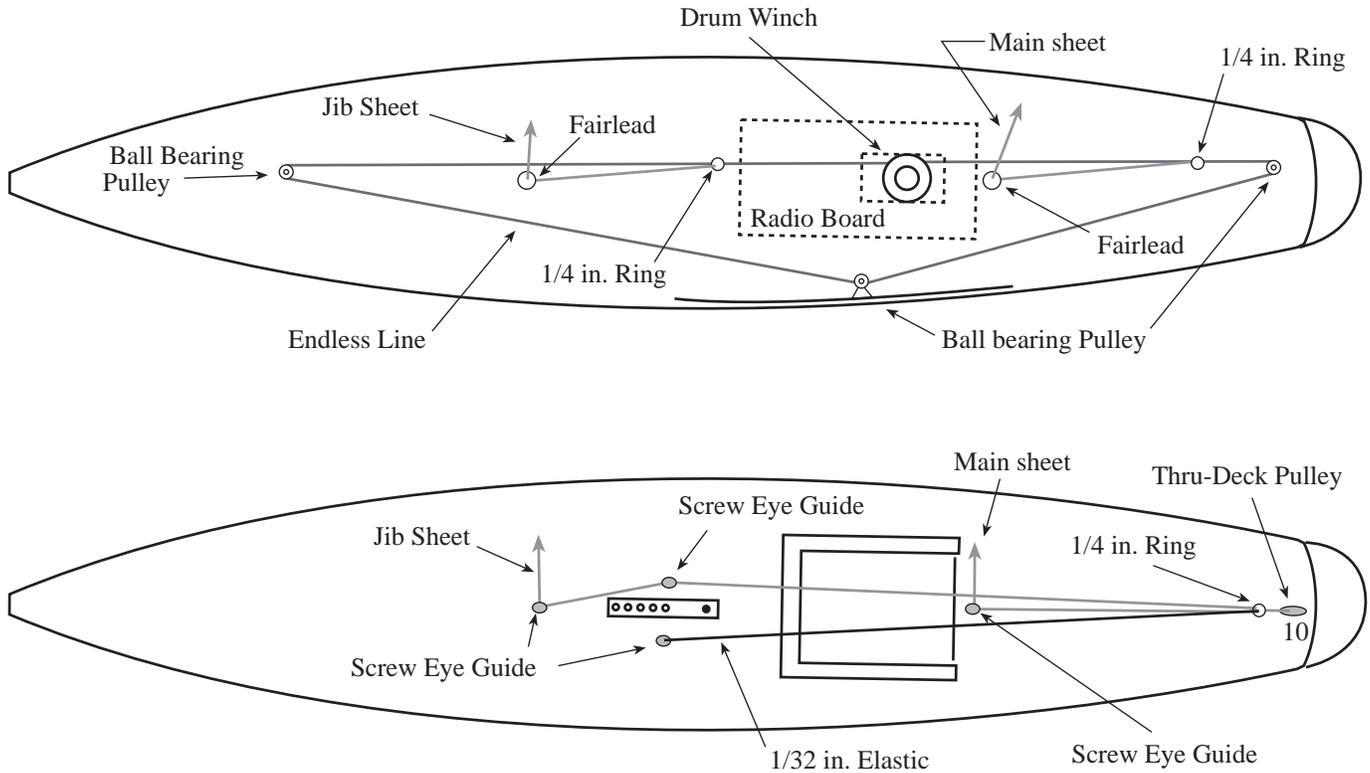
This is the sheeting arrangement used by Jim Linville for his latest US One Meter. The drum winch (a Futaba 5801) drives a loop of 80# Spectra that is lead through turning blocks at the far ends of the hull and held in tension by an elastic stretched between two rings. Sheets are fed to the booms through deck mounted fairleads. The elastic is located so that it can be replaced through the hatch.



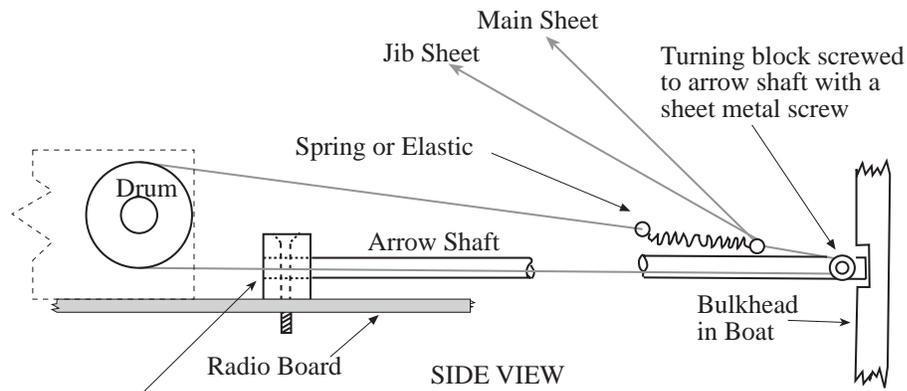
Two channel radio required.
One channel controls rudder through servo.
Second channel controls main and jib booms simultaneously through drum winch.

Sheeting tensioner of spring or elastic can be led above deck to facilitate maintenance if preferred

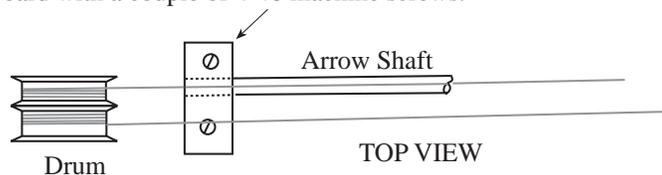
Typical method of controlling the rudder and sails of an R/C racing yacht with a two-channel radio.



Two methods of drum winch setup. Top is the "Endless Line" method. This setup can be used with the winch drum either topside or below deck. The forward, aft, and midpoint pulleys should be ball-raced. The endless line is taut at all times, and both the main and jib are attached at the appropriate points with 1/4 in. rings. Bottom is the "Single Drum/Spool Leader" method. The winch is installed so the drum is in a vertical plane. A leader line is led aft and out of the hull via a thru-deck pulley or 180° tubular exit guide. The leader line is then led forward above the deck to a 1/4 in. ring. A "tension" elastic (rubber band) and the main and jib sheets are attached to this ring and then led forward to the appropriate screw eye sheet guides. CAUTION: this system must be kept under tension at all times in order to prevent drum override. Adjust the length of the elastic so there is a slight tension on the leader line when sheeted all the way out.



Aluminum Arrow Shaft Block. Drill to fit arrow shaft and mount on removable radio board with a couple of 4-40 machine screws.



Here's a spiffy way to rig a drum winch for a Soling One Meter or similar yacht. The complete unit slides out of boat with radio board.

THE 'TRAVELLER-LESS' TRAVELLER

By Larry Robinson, Seattle MYC

Co-Author with Bob Wells of Optimizing the East Coast 12 Meter

Editor's Note: The following material is a compilation of materials found on the Seattle MYC Web Page and in the author's publication Optimizing the East Coast 12 Meter. It was originally written in February of 1998.

"Bob [Wells] has experimented with a mainsheet traveller [such as the one] shown in Figure 1 for several years. At first, he dropped the traveller too much, and found it ineffective. Later, he learned that lowering the traveller say, to 3/8 of an inch was the fastest and easiest way to correct for excessive weather helm. Good sail shape was preserved. It's easier than adjusting the rake (unless you have a jib boom adjuster). Until recently, we did not know if the traveller helped boat speed. Our current feeling is that in winds under six to eight mph, the traveller is a tuning convenience. It does not make you go faster. When the wind is in the six to eight mph range or greater, we think that we have conclusive evidence that traveller down is faster. Enough faster to make the hassle of using it worthwhile. You do not need very much offset. Three quarters of an inch is a lot of traveller. The higher the waves, the more effective it is. Once again, this confirms our idea that EC-12's sail like full size keel boats, and that the tuning lessons learned on big boats can be applied (with moderation) to the 12's.

Although Bob's traveller has worked satisfactorily, it required a lot of hardware on the deck and a turning block for the mainsheet in the stern. It was not really that esthetically pleasing. Here is what I think is a better way of achieving the traveller function. Consider that many classes feel the need for a mainsheet post, which is said to allow the main boom to be sheeted closer to the centerline without excessively reducing the main twist. If sailing conditions suggest that you do exactly the opposite, that is increase the main sheeting angle while

trying to keep the twist under control, you could lower the mainsheet exit as far as possible (instead of raising it). That would give the same effect as a traveller. The name 'traveller-less traveller' seemed as good as any for this idea.

Kelly Martin was first to actually

try it here, on his new AC boat. Figure 1 shows the idea as applied to an EC-12. The mainsheet was led to a block in bilge of the boat, and then passed up through a small transverse slit in the deck lined with Tivar (UHMW) plastic (part no. EPP851 from Laird Plastics, 1-800-610-

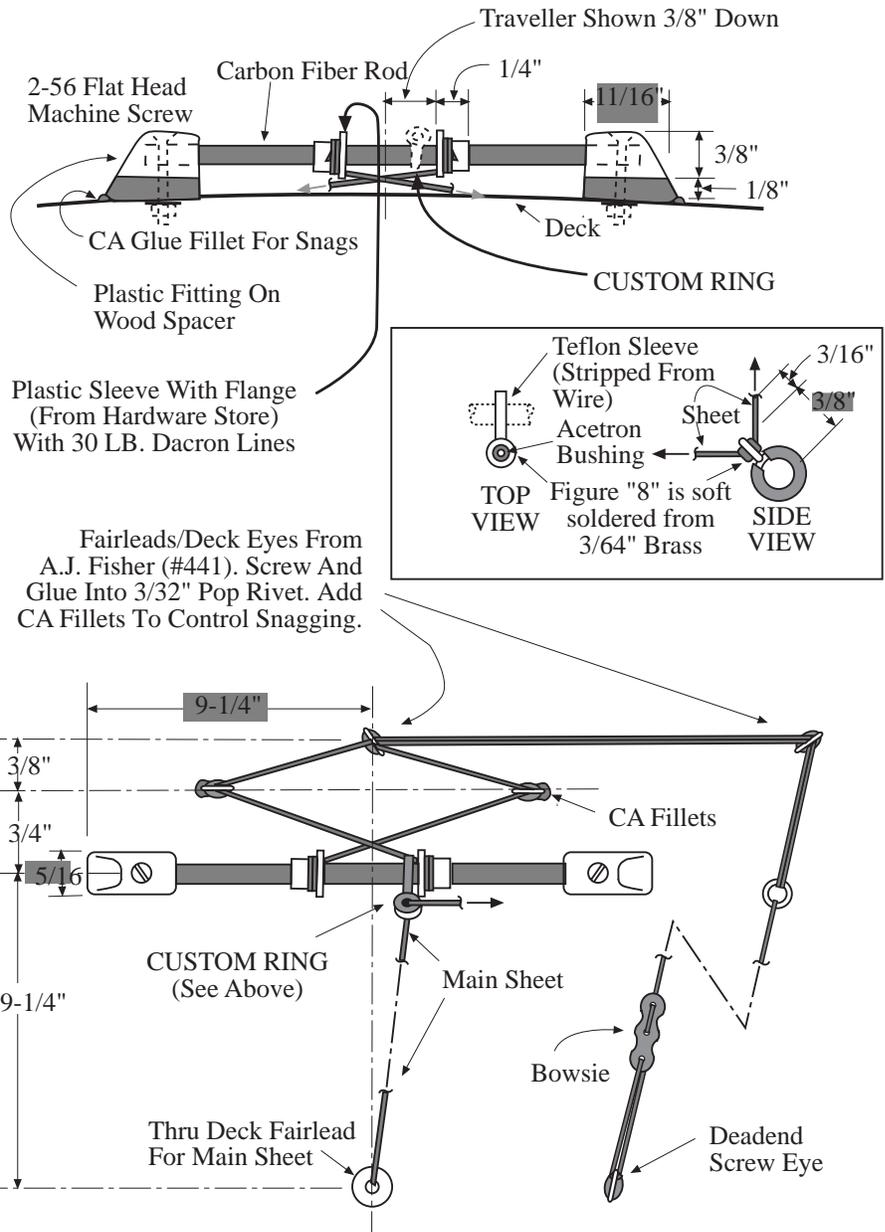


Figure 1. Main sheet traveler used by Bob Wells on his EC-12. The author believes that in winds under six to eight mph, a traveller does not make your boat go faster. However, when the wind is in the six to eight mph range or greater, a traveller increases boat speed enough to make the hassle of using it worthwhile.

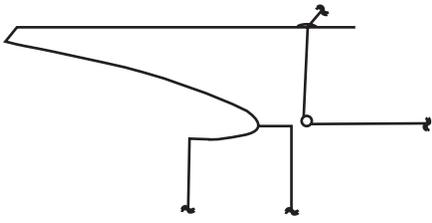


Figure 2. The mainsheet is lead to a block in the bilge of the boat, and then passed up through a small transverse slit in the deck lined with Tivar plastic.

1016). Tivar is an extremely tough and slippery plastic that is used for guides in baggage handling equipment, etc. To control the motion of the 'traveller', the mainsheet is then passed through a small bell-mouthed grommet (custom turned from Acetron). A line around the grommet passed down though an exit guide to a servo. The servo allowed the traveller to be lowered or centered by remote control.

Kelly's system has functioned properly for several seasons now. With this encouragement, Rod Carr adapted the system for his new EC-12. The EC-12 rule does not permit controlling the traveller (even of this type) by radio. So Rod's control lines are just manually adjusted as Bob's were. See Figures 2 and 3. As shown in Figure 3, the control lines, tied to the grommet, go through the exit guides, then off to a block (not shown) on the inwale. From there, the lines unite and are lead to a cleat. Rod's system has likewise worked without difficulty. (Because of the lack of a good sail test so far, the performance benefit of dropping the traveller on Rod's boat has not been proven, but we expect the same result that Bob spent several years refining.) Both Kelly's and Rod's

setups allow the traveller to be dropped, but they do not allow the traveller to be pulled to weather. Pulling it upwind would give the same effect as a mainsheet post. In classes that allow radio control of the traveller, a simple modification of the setup shown in the diagrams should allow positioning the traveller wherever you want. Lead the control lines through exit guides placed in the optional location shown in Figure 3, then to a suitably powerful servo with a two arm control horn. A better option would be to modify the servo so that it will rotate at least 180 degrees and mount a suitable drum. (Steve Young may try this on a future boat.) The diameter should be such that you have the range of traveller control that you want. M sailors, not wanting to add

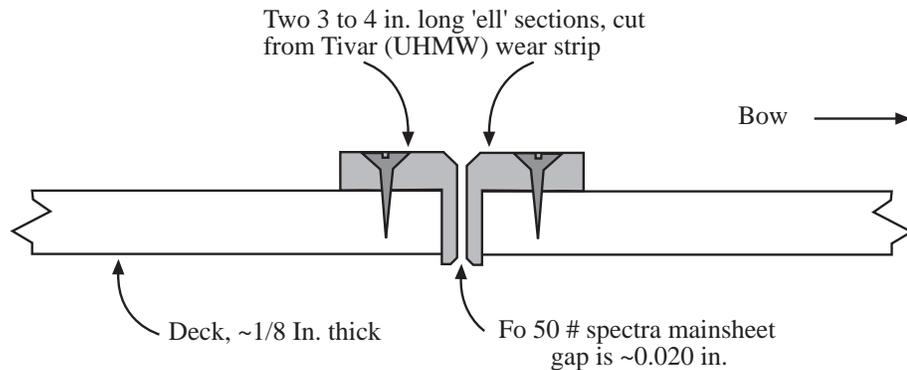


Figure 3. The mainsheet passes through a small bell-mouthed grommet (custom turned from Acetron).

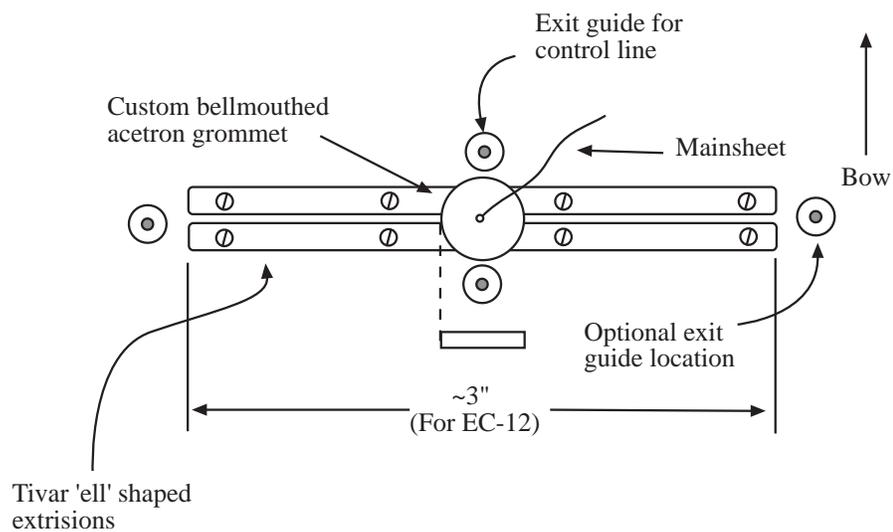


Figure 4. The control lines, tied to the grommet, go through the exit guides, then off to a block (not shown) on the inwale.

an extra servo might try incorporating the two control lines into an existing system, such that in light air, the traveller is upwind a bit, and in heavy air, the traveller is dropped some.

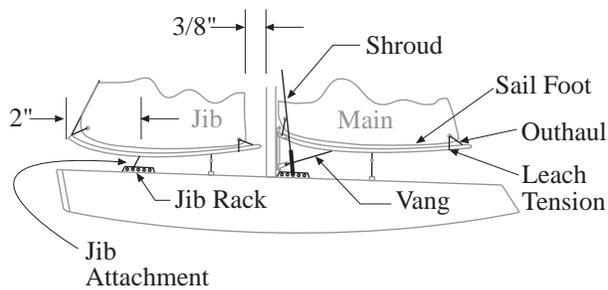
TUNING

The following are starting points for adjusting sails. They will have to be fine tuned for your specific type of rig and wind conditions.

Set foot of the Main and Jib Sail to just clear the boom. Loosely tie the leech tension line through the sail and around the boom.

To control Main twist, tighten Vang to allow 1/64" movement of boom up and down with no bending.

To control twist in Jib as wind increases, move Jib

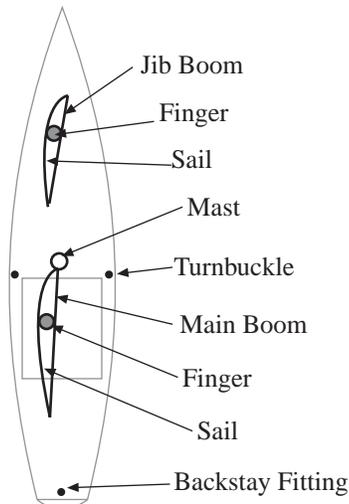


attachment back to about 2 1/2 inches. If wind is light use 1 3/4 inches. Move the attachment at boom and Jib deck rack to maintain 3/8" spacing (slot) between Jib and Mast.

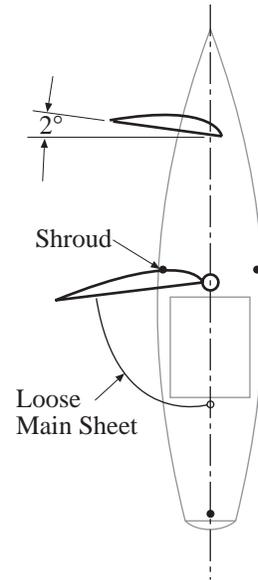
Line up end of Jib boom half way between Mast and Turnbuckle

Line up end of Main boom half way between Backstay and side of Transom.

Loosen outhaul on Main and Jib sail to allow your finger to slip between sail and boom.

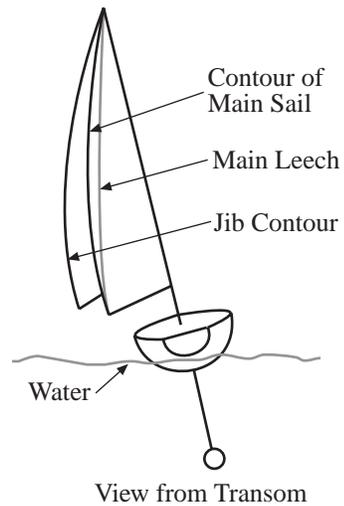


With sails let out set Jib boom approximately 2 deg. beyond right angle. Allow some slack in Main sheet. When sails are pulled in slightly the Jib will be at right



angles to centerline of yacht. Main boom remains against shroud.

Set the contour of Jig parallel to contour of Main sail.



MAIN AND JIB TRIM INTERACTION

I am quite sure that all of you are aware that when you alter the setting of either the main or jib sheet, because of the interaction of the two sails, you are affecting both sails at the same time. I don't believe, however, that most of you realize how these interactions really work, and I feel that if you understand the basics, then you will be better able to tune your boats.

First of all, you must forget the idea that the jib increases the efficiency of the main. The air flowing over the lee side of the main would actually be moving faster without the influence of the jib. In fact, the jib decreases the power available from the main, and the narrower the slot, the greater this effect. The exact opposite, however, applies to the jib. The air flow is faster over the lee side of the jib than it would be were the main not present. The main, therefore, increases the power of the jib. In addition, because of their close proximity, the jib is sailing in a continual "lift" caused by the main, while the main is constantly being "headed" by the jib. This sounds terrible, but in reality all it means is that the main is sheeted tighter than it would be if there were no jib, while the jib is sheeted more freely. The result, of course, is that the jib provides more drive, and less heeling force, while the main provides less drive, and more heeling force, per square inch of area. The net result is that while sailing to windward, the jib is much more efficient than the main.

Before you run out and build a jib-only sail rig, let me remind you that were it not for the main, the jib wouldn't look nearly so good. The performance lost by the main is (nearly) regained by the jib. In addition, the increased airspeed over the jib, plus its "lift" helps prevent luffing, while the reduced pressure change over the main caused by the slot, plus the "header" helps prevent

stalling. Therefore, the two sails interacting can have more camber, and hence more power, and can point higher, than one larger sail.

It is very important that you begin to think of the two sails acting as one large airfoil, one that has a tremendous range of adjustment. Keep in mind, the important part that the jib has in driving the boat. At all times, you must keep the jib from stalling or luffing. Use jib tell-tales, and WATCH 'EM CLOSELY. There are times, that you may intentionally stall or luff the main, which will be covered later. For the present let us try to distinguish what to expect when you make an adjustment to either the main or jib sheet. In all cases, I am assuming that you are starting from the proper sail trim. In each case, I will mention both the effect on the sail you are adjusting, and on the other sail.

Easing the Mainsheet

When you ease the mainsheet, you are rearranging the forces acting on the main in the forward direction. You will, therefore, reduce the heel and increase the drive. This is especially useful in a puff in heavy conditions, when your rig is a bit too tall, and you want to keep the boat on its feet. It will also reduce the weather helm considerably, and also the leeway, because of the reduced heel. The "lift" being provided to the jib will decrease, and both it and the main may luff. This will require that you bear off to keep the boat driving. In other words, you can't point as high with the main eased out, but the boat will heel less.

Hardening the Mainsheet

This is virtually the opposite case. When you tighten the mainsheet, you will increase the heel, and decrease the forward drive. The weather helm and the leeway will increase. The amount of "lift" felt by the jib is increased, and both the

jib and main may stall. This will require that the boat be pointed higher, and this in turn further reduces the drive available. Oversheeting the main, is therefore to be avoided, with the exception of situations requiring that you really must pinch. Be forewarned, that you cannot keep this up for more than a few boat lengths, before speed suffers, and leeway increases to the point that you will lose more than you gain. In light airs, don't pinch at all.

Easing the Jibsheet

This will increase the jib's drive, while reducing its heeling force, much as easing the mainsheet did for the main. In addition, it will increase the suction on the lee side of the main (its "power"), therefore increasing both its drive and heeling force. The change in heeling forces nearly cancel, and the result is a net increase in forward drive from

both sails. The catch is that the main is "headed" less, leading to an increased tendency to stall. There will also be an increase in weather helm, due to the Center of Effort moving aft. Generally, this is exactly what you want in light airs, providing you can accomplish it without stalling the main. You may have to bear off to avoid luffing the jib.

Hardening the Jibsheet

Again the opposite situation, where the jib's drive will be decreased, while its heeling force will be increased. The suction on the lee side of the main will be reduced, thereby reducing both its drive and heeling forces. The main will be "headed" more, and may be backwinded, forming a "bubble" just behind the mast. This reduces heeling and drive even further, and also moves the C of E ahead, and reduces weather helm considerably. This depowers the rig without affecting its pointing ability. In fact,

you may be able to pinch quite well, providing you have sufficient wind to keep up your speed.

By now you may have the idea that changing the relationship between the main and the jib could be a useful way to tune the boat for different conditions. This, of course, is exactly the idea behind a Jib Trim. It should not be used, however, as a substitute for poor tuning techniques. The boat should be trimmed for the average conditions at the time, so that the Jib Trim is just that, and not used instead of changing rigs, or rig position, when this is the proper course of action. A properly adjusted Jib Trim will enable you to

ease the jib in light airs, or to harden it up in a puff. It should never be adjusted so that it is always being kept at one end of its travel. This ties in with its biggest asset, which is finding the proper relationship between main and jib during a tuning session. When this is found, then the necessary adjustments should be made so that the Jib Trim can be returned to its middle position again.

When you are using a Jib Trim, bear in mind that any change to the jib's sheeting angle will probably require a slight course correction to keep the jib from luffing or stalling. In addition to jib luff telltales, you should have some about half way

back on the main. When the sails are trimmed properly, all telltales should flow smoothly. By coordinating the Jib Trim with the sail wench, you can do things like ease the main sheet, by first hardening the Jib Trim, and then letting out sails until the jib returns to normal. In heavy puffs you may well sail with the main luffing, and the windward telltales collapsed. By reversing the procedure, you pull in the mainsheet until it is on the verge of a stall to pinch effectively, although not for long. The Jib Trim is probably the easiest auxiliary control to learn how to use, and combined with telltales on the sails, can become almost foolproof.