

U.S. One Meter Construction Guide

Bob DeBow and Bob Jensen

with contributions by Steve Andre, Bill Turner, Jim Linville and
other members of the US One Meter class

Preface

One of the things I enjoy most about the US One Meter Class is building boats, and, in my opinion the *US One Meter Construction Guide* is a necessary reference. The *Construction Guide* was originally written by class founders Bob DeBow and Bob Jensen. Steve Andre made major contributions and produced the first computerized version. Bill Turner added new material and enhanced the drawings. My contribution is to continue adding new stuff, introduce the use of modern materials such as carbon fiber, and prepare the *Guide* for distribution on the Web.

Those of you who have built boats from scratch know that more time is spent trying to figure out where to put the mast step than building and installing it. And that's true for most parts of any scratch-built boat. For most of us the *Construction Guide* will solve this problem. The current edition has more than 50 pages of highly illustrated, expert information on subjects such as hull construction; building rudders, trunks and keels; keel bulbs; decks and hatches; sail rigging, masts and fittings; radio boards, winch sheeting, and sail trimming.

The class also keeps a library of US One Meter plans that we make available to the membership at \$3 per set. These plans range from 5 to 8 pages in length and when coupled with the *Construction Guide* provide all of the information you'll need to complete a really spiffy yacht. Currently we have 19 plans ready to be built.

For more information, contact me at the addresses below.

Jim Linville
 US One Meter Class Secretary
 57 Edgewater Road
 Hull, MA 02045

Phone (781) 925-0045
 email: us1m@amya.org

Acknowledgements

The class wishes to acknowledge the contributions of all the radio control skippers who knowingly (or unknowingly) contributed their ideas and/or materials to this publication. We've identified as many of them as possible. Additionally, many of the subjects covered in this *Guide* are reprinted from *Model Yachting*, the Quarterly Journal of the Americam Model Yachting Association, and are reprinted here for the convenience of the reader.

David Acree, Larry Robinson, Bob Wells, Harald Robinson, A.J. Moritz, Rich Dannenhoffer, Chris Jackson, Manny Costa, Rob Guyatt, Rich Danneboffer, and Scott Vernon.

THE U. S. ONE METER CLASS†

by Bill Turner

Introduction

The U.S. One Meter yacht is light weight, very fast, and responsive to the controls. It is a fun boat to sail. Due to it's size and quick disassembly it is easily transported to the pond. The U.S. One Meter is a developmental class boat. It is 39.3 inches in overall length with 600 sq. inches of measured sail area. The nonrestrictive nature of the class rules (see included class rules sheet) encourages new designs and experimentation. It is a relatively inexpensive class for the beginning skipper. The yacht can be self designed, built from plans, a purchased kit or a complete yacht, from one of several suppliers. To help the new or experienced skipper build his own boat, several plans and a construction guide are available from the class secretary.

History

The class got it's start in early 1982. During it's beginning it was known as the Olympic One-Meter class. The class was originated by Bob DeBow and Bob Jensen of San Diego, California. To use Bob DeBow's words, the class was designed with some very good reasons in mind. Some simple class specifications were drawn up. They remain basically the same today, with only a couple of minor changes to them. Materials of construction were optional so manufacturers who supported our hobby were encouraged to manufacture boats for the class. Hulls were designed to sail well in all weather conditions. The main thought behind the class specifications were that anyone with a very basic knowledge of building could gain entry to the hobby with a minimum of expense. Bob Jensen was drawing up plans one after another, and was giving them to anyone who wanted to plank up one of these great wood boats.

In the latter part of 1982 the class was rapidly gaining momentum, especially on the west coast. There were 23 Olympic One Meters sailing or under construction. Some of the designs were: Sunsong, Orco II, Bone, Skeeter, Tadpole and Tyro. The Sunsong and Orco II were available as fiberglass short kits. The Olympic One Meter is growing in leaps and bounds, and will become a class in AMYA. In the first part of 1983 it was official, the Olympic One Meter was a recognized class in AMYA and Bob De Bow is the class secretary.

In January of 1983 the first Olympic One-Meter class regatta was hosted by the Rio Salado Race Club of Arizona. There were thirteen One-Meter's entered. Included in the thirteen entries were six one-design one meters called the Arrow. The O-D Arrow was a fiberglass version of the Sunsong. Bob DeBow won the regatta, sailing a co-designed wooden hull, the Sunsong built by Bob Jensen. Swede Johnson was second, sailing his fiberglass Orco II.

The first Olympic One Meter Annual Class Championship Regatta (ACCR) was awarded to the Rio Salado Race Club. The regatta would take place in Arizona in November 1983. Rio Salado club member Bob Kruft won first place, sailing his own design, the Express. As it turned out, of the eight entries four were the Express design. The Express went on to become a very popular and fast design. John Amen started producing the Express design in fiberglass. Other manufactures were also producing fiberglass designs, Chuck Black was pumping out the Lona, Swede Johnson was laying up ORCO II's and Bob Sterne was producing the Chinook.

By 1985 the class was becoming very popular and still growing fast. The class became a part of Race Week which is hosted by the Argonauts in San Diego California every three years, and has been a part of this prestigious event ever since. The 1985 ACCR showed the beginning of a design trend change. A break from the traditional wide beam hull, to the narrow beam hulls. Swede Johnson's OCRO 85 and Curt Hurley's Scurit were both of this narrow beam design. Along with the narrow beam comes less weight and less wetted surface. The 1985 ACCR had 33 entries and was won by Bob DeBow sailing a modified ORCO 85 wooden hull.

The 1986 ACCR was hosted by the Orange County MSC in Irvine, California. The regatta was somewhat of a departure from the normal ACCR regatta, based on some of the things learned from Race Week 85. With a large number of entries entered, a three frequency conflict matrix would generally be used. This matrix had some shortcomings as to how many times each skipper races against each other, when not in conflict. Due to the number of expected entries it was decided to have a four day regatta. Which would allow a better distributed heat

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matrix. There were thirty two entries, they each sailed six races Friday and six races Saturday to accumulate a score which divided the group, into the gold ACCR fleet that raced on Monday and the silver consolation fleet that raced on Sunday. Sandy Littlejohn won the gold ACCR fleet. He was sailing a wood planked ORCO 85 hull which he borrowed from Swede Johnson. Todd Olson won the silver fleet sailing a fiberglass ORCO 85. There were a few no-show entries because of it being a four day regatta and work commitments, but the regatta was deemed a success.

In the 1987 autumn issue of the AMYA quarterly, there was a message from AMYA President Ned Helmler concerning the class name, "I have been informed that the United States Supreme Court decided that only the Olympic Committee can use the word "Olympic" therefore, the Olympic One Meter class is now the One Meter class." One year later in the 1988 autumn issue of the quarterly, in Bob DeBow's column he wrote, "Since we cannot legally call our ever growing One Meter Class an "Olympic" One Meter, the consensus among those that I have been corresponding with feel comfortable with calling our class the U.S. One Meter since the U.S. was its place of birth and development." Along with the class name change came the question about changing the logo. The logo did not need to be changed, the logo "O" represents the first letter in the word "One" which is still part of the class name.

The only change to class specification was in 1989, and it is an addition to the specification. The ballot motion M-1M-1 was: It is moved that the U.S. One Meter Class specification diagram be revised to add an end view controlling hull extensions which add to the effective keel depth, and the following paragraph was added to section 8. 8.2: Any form of platform or pedestal, as of wineglass shape, which increases effective keel depth, except as noted on drawing. The note on the specification drawing states: Pad or flat in hull to facilitate keel mounting shall not exceed 1/16 inch below contour of hull.

In October of 1990 some very sad news came to the class. Bob Jensen passed away. His passing was felt throughout the ranks of AMYA and by his many friends across the country. He was instrumental in the founding of the class, and designing and building many good U.S. One Meter's.

This covers the major historical events during the early years of the class. The class has continued to grow, but at a somewhat slower rate. During the past six years the number of registered yachts on the class roster has remained about the same. That is, you have new registrations and about the same amount that don't reregister their yacht, or renew their AMYA membership and therefore become unregistered. Throughout the history of the class there has been four class secretaries. Bob DeBow from the 1982 inception of the class until he retired in mid-year 1990. Steve Andre who took over from Bob, and adeptly guided the class through mid-year 1993. When Steve stepped down, Bill Turner was appointed the position of secretary and remained there through the first part of 2000. When Bill decided to vacate the position, Jim Linville was appointed to take over. Jim is the current secretary of the U.S. One Meter class.

There has been an Annual Class Championship Regatta (ACCR) held every year since the class became an official class of the American Model Yachting Association. That's eighteen good years of racing in the U.S. One Meter class. If you look at the ACCR class champions table, several things become apparent. There are only two repeat class champion skippers during the entire class history. Pete Jefferson is one of those skippers and Harry Bourgeois is the other. Pete won three times, 91, 95 and 97. Harry won four times, 88, 89, 90 and 92. Somehow Harry let Pete slip in there in 91. You can not find two nicer gentlemen to sail with, and both are great class champions. The second thing that is brought to your attention is the eight times Swede Johnson's ORCO design boats have been in the winners circle. In the latter years, an impressive five of the last six years Bob Sternes Venom design has led the fleet to the winners circle. The last thing, over 50% of the ACCR regattas have been held in California. The ACCR is to be rotated geographically if at all possible, it's not easy to find clubs that are willing to take on the task of hosting this event. Many thanks go out to the clubs that have hosted it.

As of May, 2000 the following manufacturers/suppliers, have one or more competitive U.S. One Meter yachts available for you to select from. Most will supply kits in any form of completeness including ready to sail.

Black Sails & R/C Model Boats (619)263-0809 Talon 2, ORCO 90

Bob's Boatyard (604)461-2547 Venom

George Ribeiro Products (831)763-0222 Meerkat, Pronto, Odom

Chips Custom Yachts (321)953-3947 Valkyrie

Graves Little Boatyard (407)453-6862 Mongoose, Suicide

U.S. ONE METER CLASS CHAMPIONS

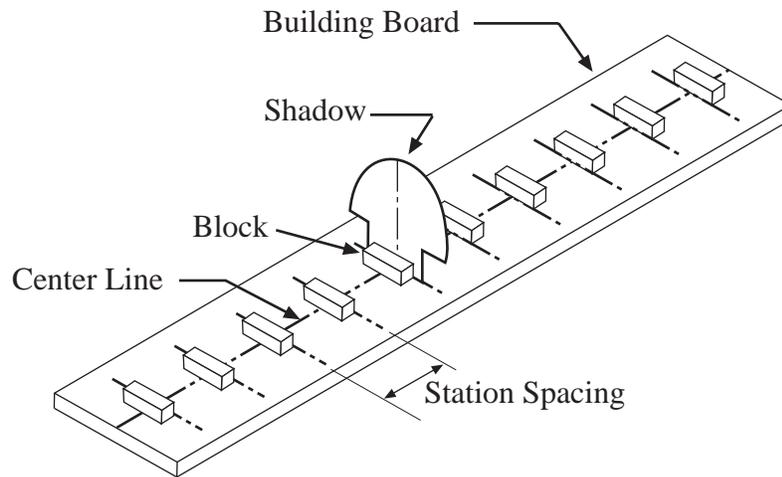
Year	Name	Hull	Beam in.	Weigh lbs.	Host Club	Location
1983	Bob Krufft	Express, wood	na	8.0	Rio Salado RC	Mesa, AZ
1984	Terry Allen	Express, wood	na	na	San Diego Argonauts	San Diego, CA
1985	Bob DeBow	ORCO wood (modified)	7.5	na	San Diego Argonauts	Race week, CA.
1986	Sandy Littlejohn (gold fleet)	ORCO, wood (Gold Fleet)	6.0	7.5	Orange County MSC	Irvine, CA.
1986	Todd Olson (silver fleet)	ORCO, fiberglass (silver Fleet)	5.5	na	Orange County MSC	Irvine, CA.
1987	Wick Smith	Mistral, wood (modified)	8.0	7.3	Detroit, MYC	Clarkston, MI.
1988	Harry Bourgeois	ORCO, skinny fiberglass	5.5	7.0	San Diego Argonauts	Race week, CA.
1989	Harry Bourgeois	ORCO, skinny fiberglass	5.5	6.5	Miami Valley MYC	Dayton, OH.
1990	Harry Bourgeois	ORCO, skinny fiberglass	5.5	5.8	Mesa MYC	Mesa, AZ.
1991	Pete Jefferson	ORCO, 90 (modified)	5.2	6.0	San Diego Argonauts	Race week, CA.
1992	Harry Bourgeois	ORCO, skinny fiberglass	5.5	5.8	Orange County MSC	Irvine, CA.
1993	Steve Andre	Zipper, carbon fiber	5.3	5.4	Miami Valley MYC	Dayton, OH.
1994	Bob Sterne	Venom, kevlar	7.0	5.5	San Diego Argonauts	Race week, CA.
1995	Pete Jefferson	Venom, kevlar	7.0	5.5	Mid-Atlantic MYC	Mt. Laurel, NJ.
1996	Paul Brown	Venom, kevlar	7.0	5.5	Orange County MSC	Irvine, CA.
1997	Pete Jefferson	Venom, kevlar	7.0	5.5	San Diego Argonauts	Race week, CA.
1998	Steve Spatenga	Yellowbird	6.8	6.3	Space Coast MYC	Melbourne, FL.
1999	Mike Fujita	Venom, kevlar	6.8	5.3	Tri-City MYC	Placentia, CA.
2000	Mike Fujita	Venom, kevlar	6.8	5.3	Tri-City MYC	Race week, CA.

Table of Contents

PREFACE	3
ACKNOWLEDGMENTS	3
HISTORY OF THE U. S. ONE METER CLASS	5
U. S. ONE METER CLASS CHAMPIONS	7
HULL BUILDING BOARD	11
BALSA STRIPPER	12
HOW TO STRETCH BALSAWOOD	13
PLANKING THE HULL	14
TRANSOM	16
LAYING FIBERGLASS CLOTH ON YOUR HULL	17
FIN AND RUDDER JIG	18
KEELS	19
HULL REINFORCEMENT FOR	19
BOLT-ON KEEL	19
MOUNTING A BOLT-ON KEEL	20
FULL HEIGHT FIN TRUNK	21
HAL ROBINSON'S COMBINATION MAST STEP AND KEEL FIN TRUNK	21
TRUNK TYPE FIN WITH ALUMINUM TUBE	22
SHORT FIN TRUNK	23
ATTACHING BULB	24
TO FIN WITH ALUMINUM TUBE	24
ATTACHING BULB TO FIN	25
LEAD BULB CASTING	26
Bulb Pattern	26
Lead Shot and Resin Method	26
Poured Lead Method	27
KEEL BULB SHAPE	28
RUDDERS	29
RUDDER LOG	29
PUSHRODS	30
ARROWSHAFT DRILLING JIG	30
DECKS AND HATCHES	31
Soft Deck	31
Plywood Deck	31
More Soft Deck	32
Hatch Coaming and Cover	32
Milk Bottle Caps	32
Sliding Hatch	32
MASTS	33
Jackline method:	34
Mast loop method:	34

RUNNING RIGGING	35
MAST HEAD CRANE	35
MAKING A MAST FROM A CARBON FIBER KITE SPAR	37
SAILS	38
MAST SUPPORTS	39
MAST SUPPORT FOR BOATS WITH BOLT ON KEE	40
TYPICAL SHEETING FOR A TYPICAL BOOM CLUB	41
RIGGING THE TACK END OF A JIB CLUB	41
RIGGING THE CLEW OF A TYPICAL MAIN BOOM OR JIB CLUB.	41
ARROW SHAFTS	41
ARROW SHAFT BOOM	42
JIB TWITCHER	42
FITTINGS	44
GOOSENECKS	44
HOME MADE TURNING BLOCKS	44
TURNBUCKLES	46
RADIO BOXES AND BOARDS	48
PROPORTIONAL WINCH LAYOUT	49
SERCO CONNECTORS	50
CONVERTING A 90° WINCH TO 180° OPERATION	51
RADIOBOARD WITH 2 S-125'S	52
AND 2 CHANNEL RECEIVER	52
CONVERING A FUTABA S148 TO A DRUM WINCH	53
RADIOBOARD WITH 2 S-125'S	54
AND 4 CHANNEL RECEIVER	54
CONVERTING THE FUTABA S3801 TO 180 DEGREES ROTATION	55
ARM WINCH SETUP	57
SCU AND SHEETING	57
SINGLE ARM WINCH SHEETING	58
DRUM WINCH SETUP	59
"TRAVELERLESS" TRAVELER	61
TUNING	63
MAIN AND JIB TRIM INTERACTION	64

HULL BUILDING BOARD

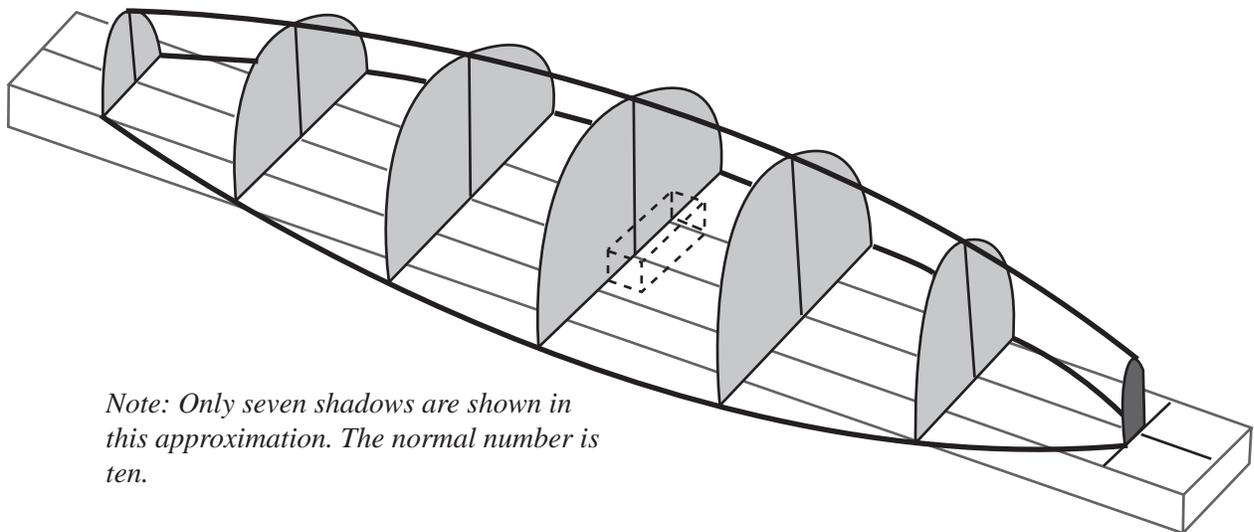


The board has to be “warp-free”. It can be plywood or particle board shelving material. Particle board is a little more difficult to cut and drive nails into than plywood. Size of the board is about 5/8" x 12" x 48". If you want to keep the board clean, cover it with shelf paper.

Draw a center line on the length of the board. Draw station spacing lines at right angles to the center line. Make sure the spacing is correct for the hull design. Lightly nail small wood blocks (about 3/4" x 3/4" x 2") to board at station spacing lines. Note that blocks are placed in front of station lines 1 thru 5 and behind sta-

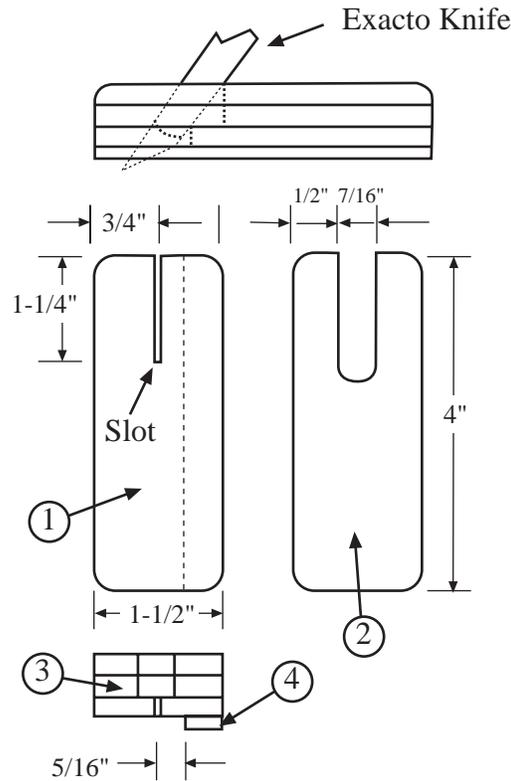
tion lines 6 thru 10. Do not drive nails “home”. They will be removed later.

Trace shadows (frames or formers) on 1/8" thick “doorskin” plywood or untempered hardboard. These shadows will be discarded later. Be sure you have a center line on each shadow. Cut out shadows, and sand any rough spots. Glue shadows to blocks on building board. Use 5 Minute Epoxy or hot glue. Be sure center line on the shadows lines up with center line on building board.



Note: Only seven shadows are shown in this approximation. The normal number is ten.

BALSA STRIPPER



1. 1/4" thick plywood (make one). Notice slot is cut at slight angle.
2. 1/4" thick plywood make two.
3. Glue 1 and 2 together. Use 5- minute epoxy or Zap.
4. Glue 1/8" x 7/16" x 4" pine fence (strip) in place as shown. This fence determines the width of balsa strip to be cut. Change this dimension to suit your strip width.

Slightly round the top edges.

Lay balsa sheet on flat workboard or similar cutting surface. Grasp stripper between thumb and last three fingers of right hand.

Insert X-ACTO (or similar) knife in slot. Hold in place with right index finger. Place fence against edge of balsa sheet. Draw stripper slowly along edge keeping fence pressed firmly against edge. Make two or three passes if necessary.

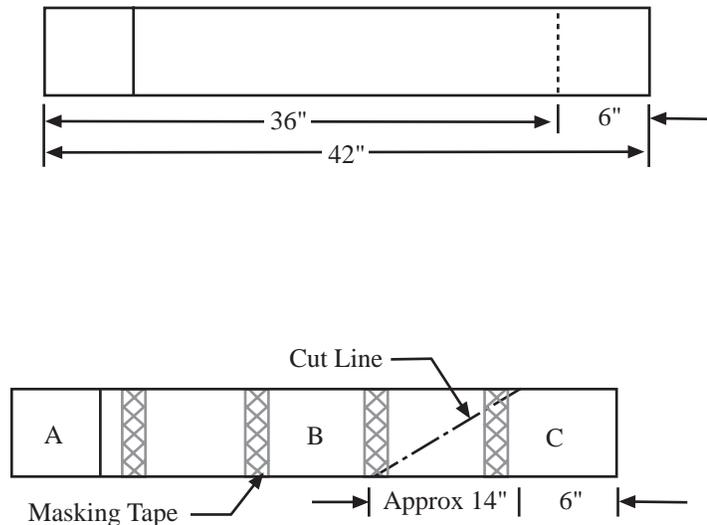
SOUTHPAWS TAKE NOTICE !!!

A left handed version can be made by reversing the plan.

EASY WAY OUT

You can buy one from the hobby shop for a couple of bucks.

HOW TO STRETCH BALSAWOOD



You want to build a model boat that is 40" long and the only sheet basla available is 36" long. What do you do? You "scarf" the balsa sheets, that's what you do.

Place two 1/8" X 4" X 36" (or whatever thickness and width you are using) balsa sheets together with the top sheet extending 6" beyond the bottom sheet (Fig. 1). Tape sheets together using masking tape. Draw a light pencil line as shown by dotted line (Fig.2). Cut both sheets along this line using a jig saw or band saw. An X-ACTO type knife can also be used. Be sure to keep the knife blade perpendicular to balsa sheets.

Place a sheet of wax paper or other plastic wrap (kitchen items) on a flat surface. Place section A and

C together on the wax paper as shown in Fig. 2. Use masking tape or weights to hold sheets in position. Run a bead of CA glue (Zap, Hot Stuff, ect., "gap filling" type) along seam. White or carpenter's glue may also be used but takes longer to set.

Make a second sheet by reversing section B and proceeding as before. You will have 3 pieces of scrap material left over. Repeat this procedure until you have enough sheets to plank your hull.

Strip sheets into planks of the desired width with your balsa stripper.

Be sure to "stagger" the joints when planking. Plank carefully and the joints will be barely noticeable.

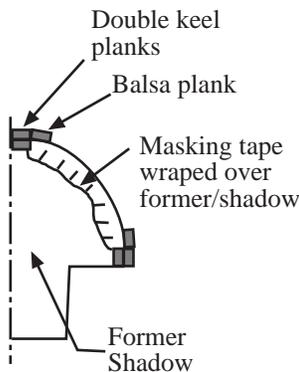
PLANKING THE HULL

To build a straight hull you must have a sturdy jig to hold the station formers in alignment with the keel center line, they also must be perpendicular to the center line both vertically and horizontally.

Draw or trace the station former out- lines on paper, cut them out and glue them to the former material with rubber cement. You can use 1/8" thick door skin plywood (or any other suitable material) for former material. Cut the formers out and sand the edges to conform to the paper templates.

Cover the edges of the formers with masking tape, where the hull planking will make contact. This helps prevent the glue from sticking to the formers. Now attach the formers to the building jig. Make sure station spacing and former alignment is correct.

Before we start building lets talk about materials used

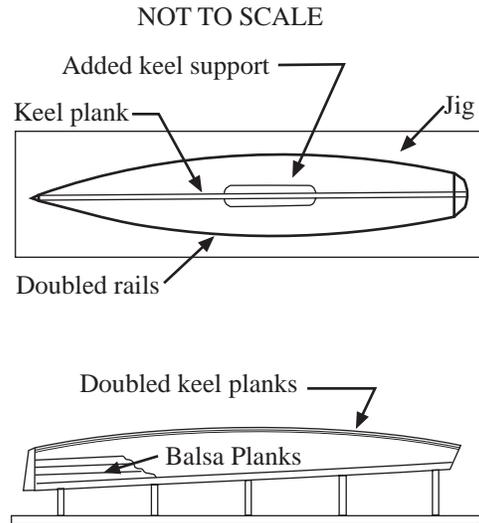


in the construction of the hull. The keel plank and deck rails are 1/8" th. X 1/4" wide strips of pine or basswood. The hull is planked with contest grade "lite" density balsa wood strips. Balsa comes in several densities. If you use hard density wood its not as easy to form the strips to the formers and the hull starts getting a little heavy. You can buy 1/8" th. X 3" wide X 48" long balsa sheets. Use a balsa stripper to cut the sheets into 5/16" wide strips for planking (you can't buy precut strips in this width and this is about the maximum width for easy planking). "Zap CA thin" glue can be used through out the construction of the hull. It will bond almost anything, including your fingers and sets up almost instantly. The joints must be tight, because the glue will not fill gaps.

Therefore if you have any gaps, fill them with Micro-Balloon filler or balsa dust, and then Zap it.

Ok lets start planking the hull. Lay in the first 1/4" wide pine keel plank and glue to each former. Glue a second pine plank on top of the first plank. Do this by pressing a few inches of the second plank tightly against the first plank and apply Zap to the edge where the planks meet. Capillary action will suck the glue between the planks. Continue this for the full length of the planks. For added strength in the keel fin area, glue a short 1/4" wide pine plank against both sides of the keel planking between formers 4 and 7. Install the deck rails on both sides with double planks of pine in the same manner as the keel planks.

Start the balsa planking at the deck rail, making sure the plank is tight against the deck rail edge. Zap the edge joint as you move along the length of the hull.



Continue laying planks making sure the edges are tight and that they follow the curve of the hull and are against the formers. Lay in about four planks on one side and then switch to the other side. Continue to plank the sides until you get near the water line at the bow. Glue a balsa plank along the hull bottom against the pine keel plank. Do both sides of the keel this way. For the remainder of the planking, trial fit each plank for length and end shape before gluing. When you lay flat planking strips against the curved area of the formers, the gluing edges don't meet squarely and you get a slight gapping of the edges. To

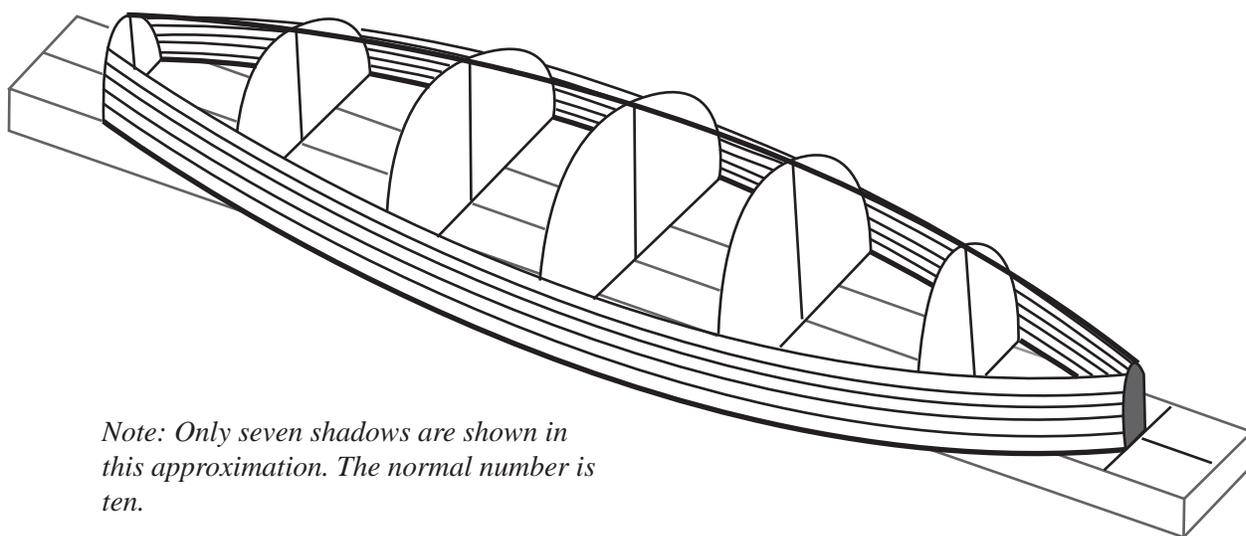
eliminate this, use a sanding block to put a slight angle on the edge of the plank to be glued in. It doesn't take much, just a swipe or two with the sanding block down the edge of the plank.

When the planking is completed, trim and sand flush any planking extending past the bow and stern formers.

Ok its time to sand the hull. Use a sanding block with 100 grit Garnet paper. Its important to use sharp (new) sandpaper. As soon as it starts getting dull change it.

Don't press hard on the sanding block, because it will cause low spots in the hull. The glue line between each plank is harder than the balsa wood, to prevent ridging of the glue line, sand diagonally across the planking. Rub your hand over the hull, and you can feel the bad spots easier than you can see them. When the hull feels and looks good, finish up with a light free-hand (no sanding block) sanding using 120 grit paper. Remember balsa wood sands fast and easy and the planking is only 1/8" thick.

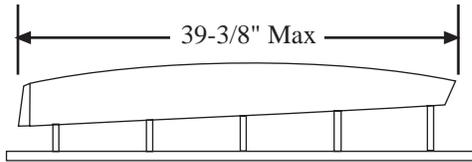
Install the keel, ruder log and rudder, deck beams and hatch cover. These items are covered in other sections of the construction guide.



Note: Only seven shadows are shown in this approximation. The normal number is ten.

TRANSOM

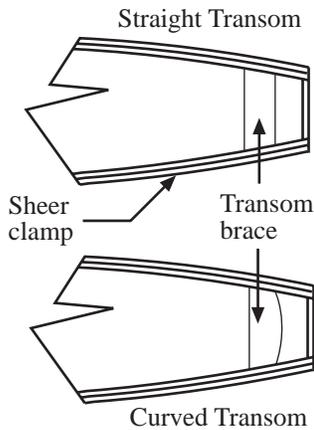
Here's an easy way to make an attractive transom on your new hull.



When the hull is planked, nose piece or bumper installed, hull sanded and **BEFORE** you remove the frames, place the hull on a flat surface. Measure the hull for over-all length. The maximum L.O.A. for a One Meter yacht is 39 3/8". Minimum is 39". This is measured parallel to the waterline.

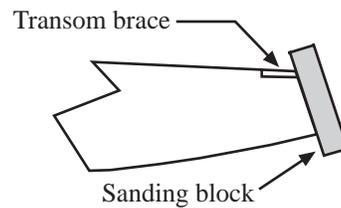
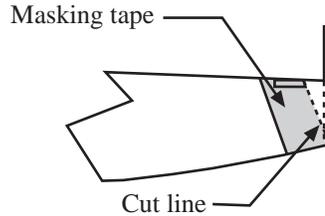
Fit and glue a 1/8" thick plywood transom brace between sheer clamps.

Apply masking tape to give proper cut line. Use the



edge of the tape as a guide and cut through the clamps, planking and keel. Discard the last frame.

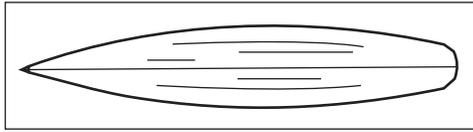
Use a sanding block to true and bevel edges. Glue a small sheet of 1/16" plywood across the open end of



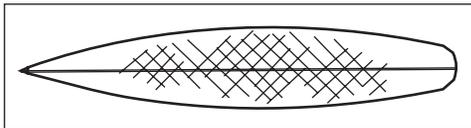
the hull. Trim and sand to final shape.

BE SURE OVERALL LENGTH DOES NOT EXCEED 39 3/8".

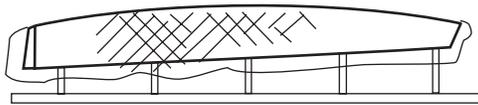
LAYING FIBERGLASS CLOTH ON YOUR HULL



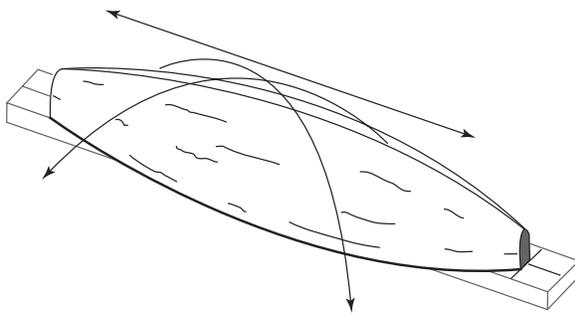
Sand hull smooth with 100 grit sandpaper. Fill in all gaps in planking and any low spots. Finish sand with 120 grit sandpaper.



Place 1 oz. fiberglass cloth over dry hull, with fibers running approximately 45° to keel. Smooth out fiberglass cloth with palm of your hand over entire hull (except transom).



Trim fiberglass cloth approximately 1" from edges of hull.



Gently apply resin or epoxy to the hull, starting in center of keel and work toward bow and stern. Apply resin or epoxy to the remainder of the hull using a downward motion and let cure.

Note:

If you are working with epoxy, thin approximately 30% with Isopropyl Alcohol to allow an even flow.

Trim all excess fiberglass from the hull, using a sharp knife or single edge razor blade. Trimming is easiest if resin is "green" (not completely cured).

When resin is dry, sand the hull with 225 grit "wet or dry" sandpaper to remove curtains and runs. If you used epoxy you will notice a feeling of oil on the un-sanded surface. This can be wiped off with alcohol or acetone and then sanded.

Note:

If you use polyester resin;

Use laminating resin for the 1st coat.

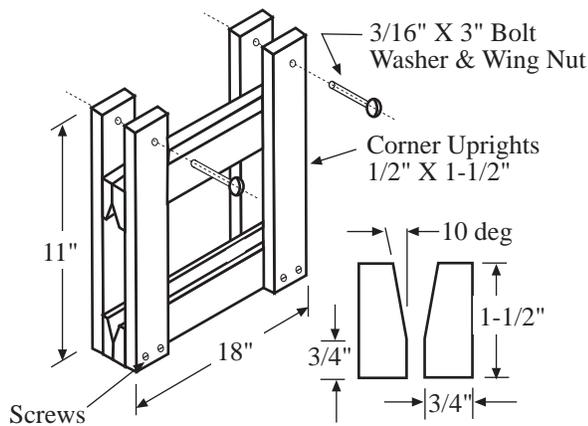
Use sanding resin for the 2nd coat.

Use finishing resin for the 3rd or last coat.

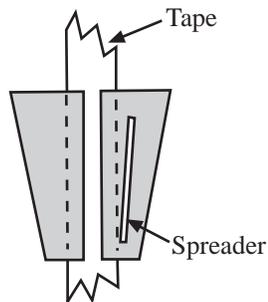
Your hull can be finished with a thin coat of high grade spar varnish or clear two-part epoxy paint.

FIN AND RUDDER JIG

The jig holds the fin or rudder in good alignment while the glue cures, and helps produce a straight fin or rudder. You can change the size of the jig to suit your needs. It's best to glue and/or screw the clamp bar pieces together (both upper and lower) before assembling the corner uprights to them. You can vary the air foil thickness of the fin or rudder by putting more or less angle in the clamp bar. More angle increases air foil thickness.



Fin or rudder skin materials can be, plywood, epoxy sheet, plastic sheet, Formica or similar material.



How To Use The Jig

- Place masking tape (sticky side up) on flat surface.
- Place fin sides on tape (inside up). Leave 1/16" gap between leading edges. It helps in the final shaping to taper material thickness on the inside edges of both the leading and trailing edges.
- Epoxy tapered spreader in place. The thickest end at top, the thickness depends on your airfoil thickness. The spreader is not needed in rudders.
- Put a sheet of plastic wrap or waxpaper in the groove of the lower block, to prevent glue from sticking to the block.
- Apply liberal amounts of epoxy to leading edge and spreader. Fold fin halves, pinch tape ends together. Place in lower grooved block of jig.
- Lower upper grooved block to make contact with fin, you may have to angle the block to match the angle of the fin. Tighten the wing nuts slightly to hold everything in place.
- Remove fin from jig when epoxy has set.
- Apply epoxy to inside surface of trailing edge. Pinch the edges together and place in lower grooved block. Lower the upper grooved block to clamp everything in place. Don't forget the plastic wrap!
- Remove fin after the epoxy has set.

KEELS

Keels can be either of the bolt-on type or the trunk type. They can be made from the following materials:

- Formica outer skin
- Aircraft plywood outer skin
- Solid shaped marine plywood
- Solid shaped aluminum stock
- Molded carbon fiber

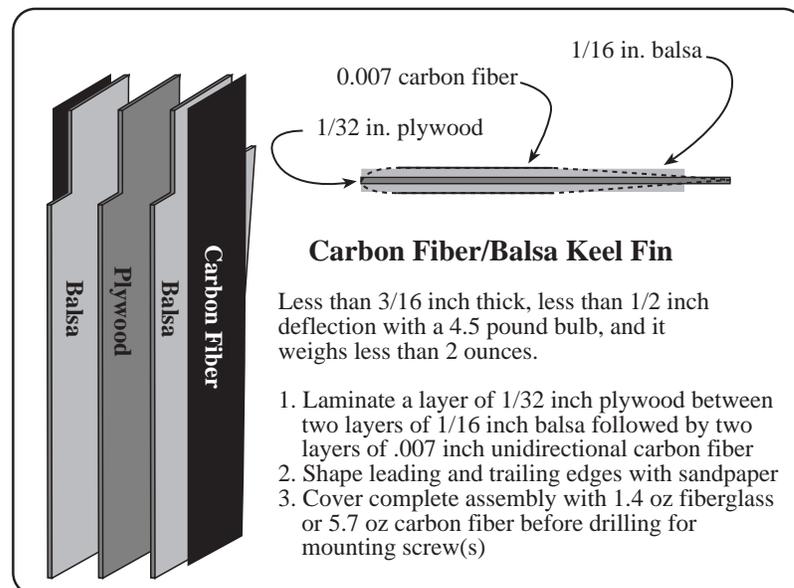
The lightest, strongest, and most expensive keels are made from molded carbon fiber, available from some model boat vendors.

Aluminum fins are strong but heavy relative to fins made from carbon fiber or "skins".

Keels made from skins of Formica or aircraft plywood are the easiest to make with the use of a fin jig. They require a stiff spar material in the center of the fin. They're usually the least expensive.

Fins that insert into a trunk within the hull have less bend at the interface between the hull and the keel than keels that bolt to the bottom of the hull.

The following pages show alternate methods of making and mounting keels, and mounting bulbs to keel the fin.



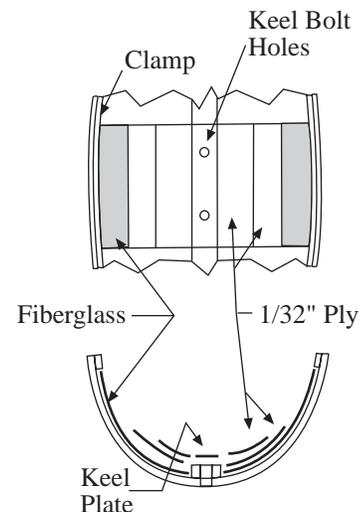
HULL REINFORCEMENT FOR BOLT-ON KEEL

Lay in fiberglass cloth the width of the top of the keel plus 1" fore and aft, from clamp to clamp. Allow resin to completely cure.

Cut and install 4 pieces of 1/32" plywood and sand both sides. Glue to fiberglass cloth with slow cure epoxy (with filler) and weight down to follow hull contour. Grain of wood should run fore and aft for ease of bending.

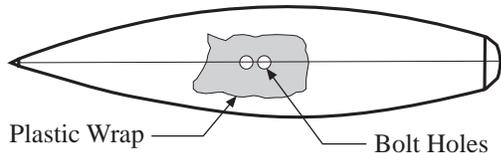
Install keel plate on keel, 1/16" sheet Formica (or any hard material) with slow cure epoxy. The plate keeps the keel bolts from deforming the wood keel plank.

Drill bolt holes to match your keel.



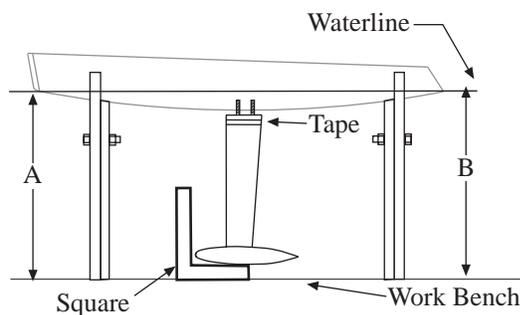
MOUNTING A BOLT-ON KEEL

Locate and drill holes in bottom of hull to accept keel bolts. Waterproof holes.



Cover bottom of hull around bolt holes with thin plastic wrap. Tape the wrap to hull. Punch holes in plastic wrap for keel bolts.

Support yacht hull in stand and measure from waterline to work bench at bow and stern. Dimensions A and B should be equal.

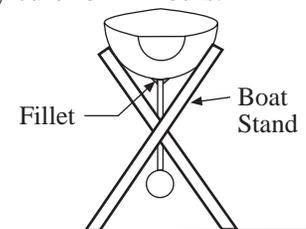


Place masking tape around upper portion of keel fin approximately 1/2" from top. Apply thin layer of slow cure epoxy with a filler (micro-balloons) additive to top outside surface of keel fin. CAUTION: Be sure the epoxy is not close enough to bolts to be forced up into bolt holes when mounting keel.

Press keel up into the hull until the epoxy starts to touch. Place nuts on bolts inside hull and gently hold bottom of keel. Screw the nuts down on keel bolts until enough epoxy shows on the sides of keel to create a fillet.

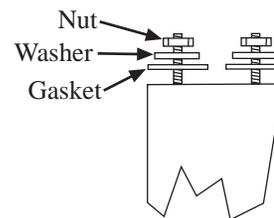
Use a square and line up the leading edge of keel fin to square. If your fin trailing edge is the one that should be perpendicular to the waterline, use this edge to line up with the square. Use keel nuts to adjust for squareness of the keel. Sight from the transom to ensure keel is vertically straight. Gently smooth down the fillet with finger or round edge of stick.

Let epoxy cure for 24 hours.



Remove keel, tape and plastic wrap from hull. Sand and paint as required.

When attaching the completed keel to the hull, be



sure to use gaskets, washers and nuts in that order. To prevent water from entering hull through mounting holes. Gaskets can be made from neoprene faucet washers, bicycle inner tube material, etc..

FULL HEIGHT FIN TRUNK

The full height fin trunk serves a dual purpose, it secures the fin to the hull and acts as a mast support.

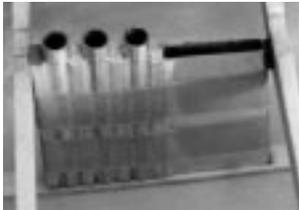
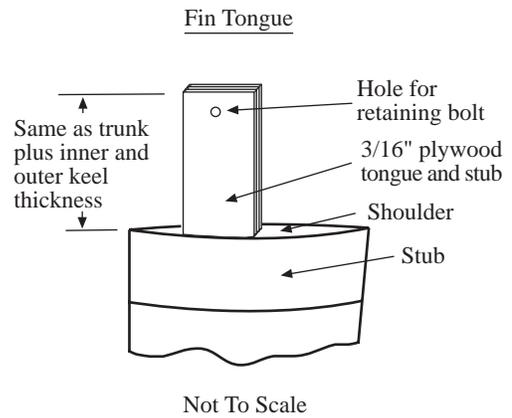
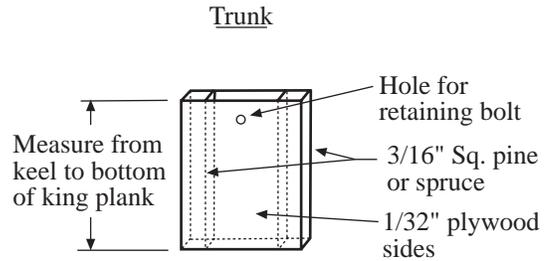
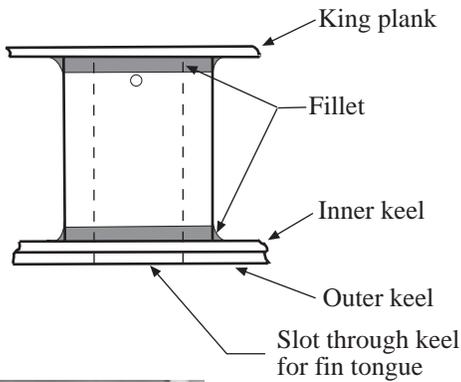
The trunk fits between the king plank and inner keel. The trunk sides and fin tongue are made from Birch 4 ply aircraft plywood. Make the fin tongue and stub from one piece of plywood. The trunk must be a good snug fit on the fin tongue.

Locate and cut a slot through both the inner and outer keel planks. Glue the trunk in the hull with epoxy or micro-balloons and Zap. Build a fillet around the joints. These joints bear heavy stresses and must be absolutely water tight.

Insert the fin tongue through the slot in the keel, push up until shoulder is snug against hull bottom.

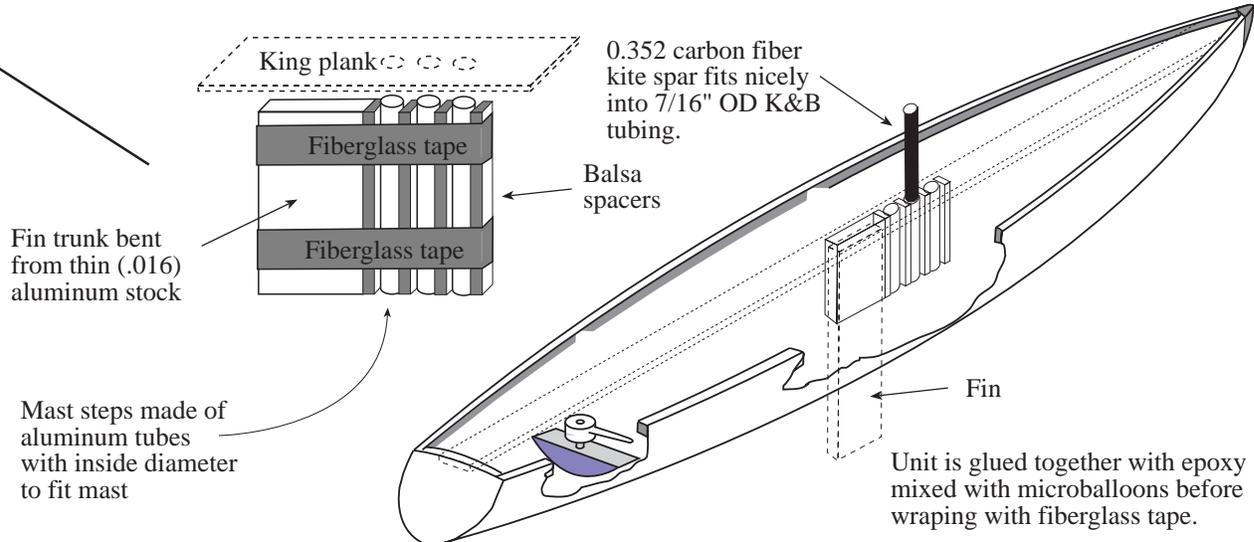
A small bolt and wing nut holds the fin in place.

Waterproof fin, and trunk both inside and out.



Hal Robinson's Combination Mast Step and Keel Fin Trunk

The beauty of this unit is its simplicity and the fact that it automatically assures proper mast and fin alignment.



TRUNK TYPE FIN WITH ALUMINUM TUBE

This type fin has a trunk for mounting to the hull, and is removable from the hull. The fin is built up of 1/32" skin material and spruce stringers and aluminum tube for strength. The finished weight of the fin is 3.5 ounces.

Skin material is 1/32" thick aircraft plywood or "Vertical" Formica.

The aluminum tubing is 0.25" O.D. heat treated to the T-6 hard condition. Tube wall thickness is 0.060", this will make I.D. suitable for 8-32 tapping.

There are two spruce stringers, one forward and one aft of the aluminum tube.

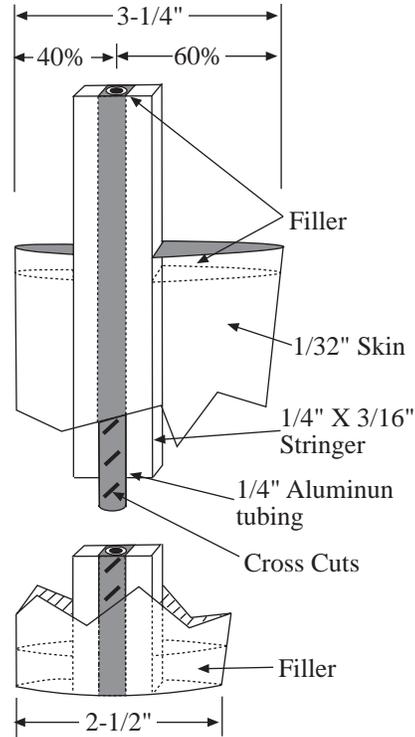
File or grind 1/32" off opposite sides of the aluminum tube for the full length of the tube; they need to be flush with the stringers so the flat sides of the tube lay against the insides of the skins.

Cross-cut the aluminum tube to a depth of 1/16" every 5/8" along the two flat sides, so the tube will "lock" in place when epoxied to the skins.

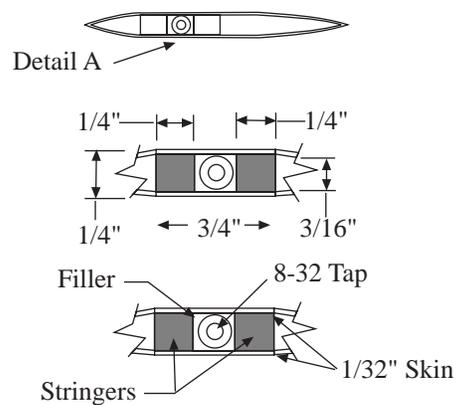
The top and bottom of the fin is filled with a filler of micro-balloons and epoxy or resin.

Tap 8-32 thread 1" deep on each end of the aluminum tube. For holding the fin in the hull and mounting the bulb to the fin.

Be sure to put a good water proof finish on the fin.



Top View



Detail A

Not To Scale

SHORT FIN TRUNK

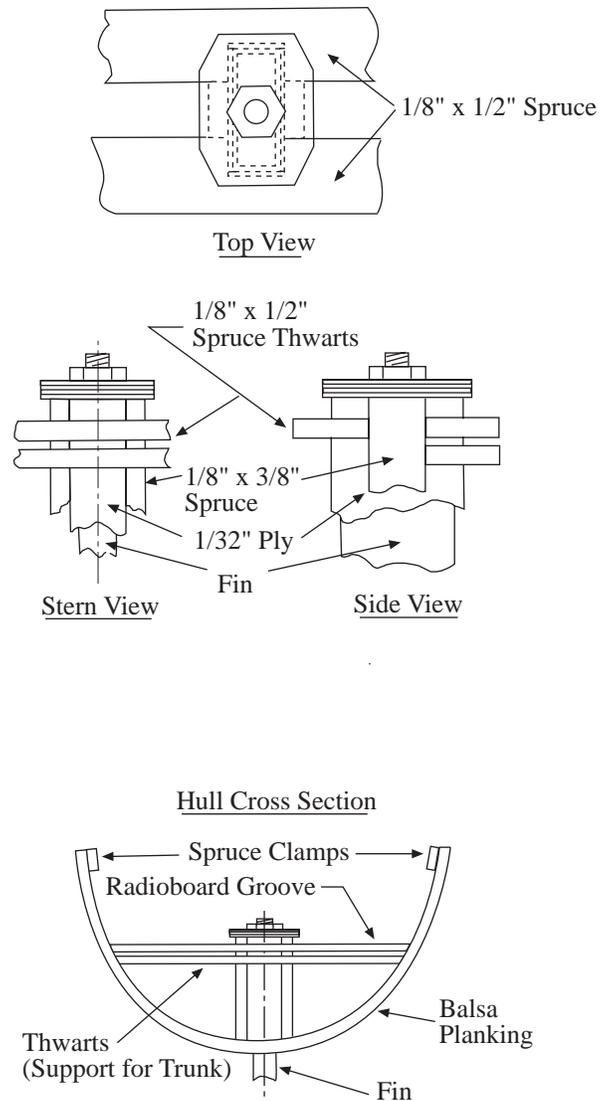
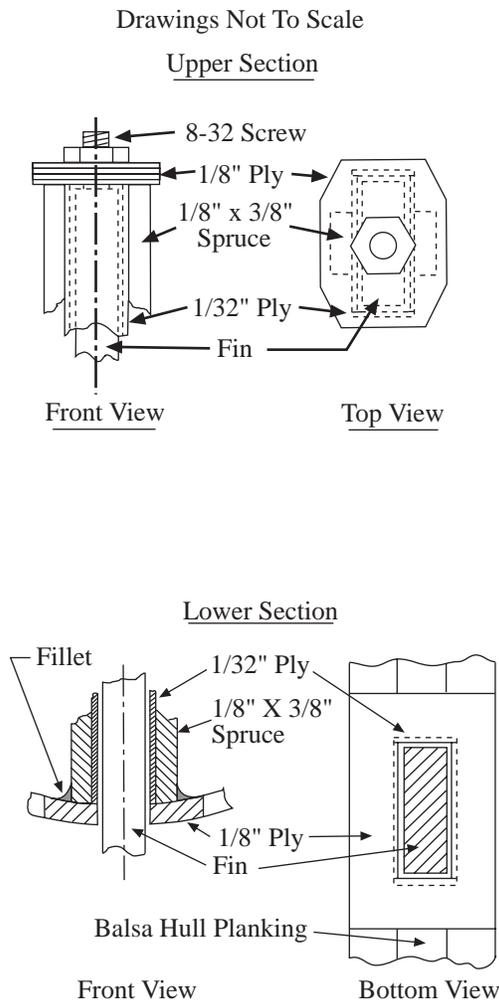
A short fin trunk will allow an arm type Sail Control Unit (SCU) to swing through an obstructed

The 8-32 stainless screw (with the head cut off) is used as a stud, screwed into the top of the fin. Secure fin in trunk with washer and hex or wing nut placed on stud.

The fin should be a snug fit in the trunk.

Make a strong water tight fillet at the junction of the trunk and hull bottom, use epoxy and 1/2 oz fiberglass or micro-balloons and Zap.

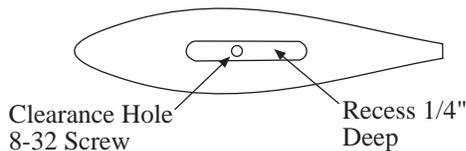
The groove between the aft thwarts can be used for radioboard mounting.



ATTACHING BULB TO FIN WITH ALUMINUM TUBE

Mounting the bulb to fin with a screw allows you to easily change the bulb, so you can experiment with different bulb weights.

Be careful when drilling the clearance hole for the 8-32 machine screw through the lead bulb, the lead wants to grab onto the drill bit. To help prevent this, use lots of cutting oil and frequently clean the lead from the drill bit.

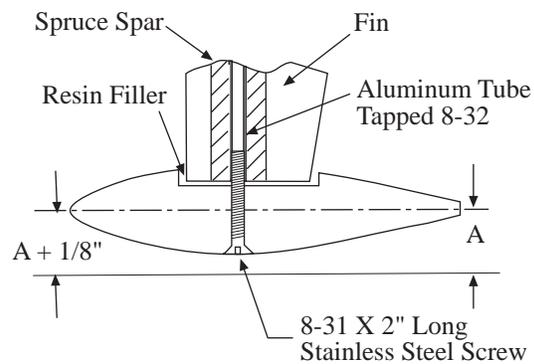


You can make the 1/4" deep recess in the bulb with a moto-tool or rotary bit in a drill motor.

Tap the bottom of the fin with the 8-32 tap about 1/2" deep.

If you want the bulb removable from the fin, smear a little heavy grease on the bottom of the fin and up the sides about 1/2". This keeps the resin from adhering to the fin.

Attach the bulb to the fin with the screw. Make sure it's aligned straight fore and aft with the fin, and the forward tip of the bulb is about 1/8" higher than the aft end of the bulb.

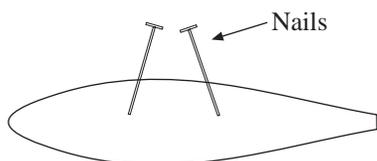


Fill the cavity around the fin with a filler of resin and micro-balloons. Allow to cure for 24 hrs.

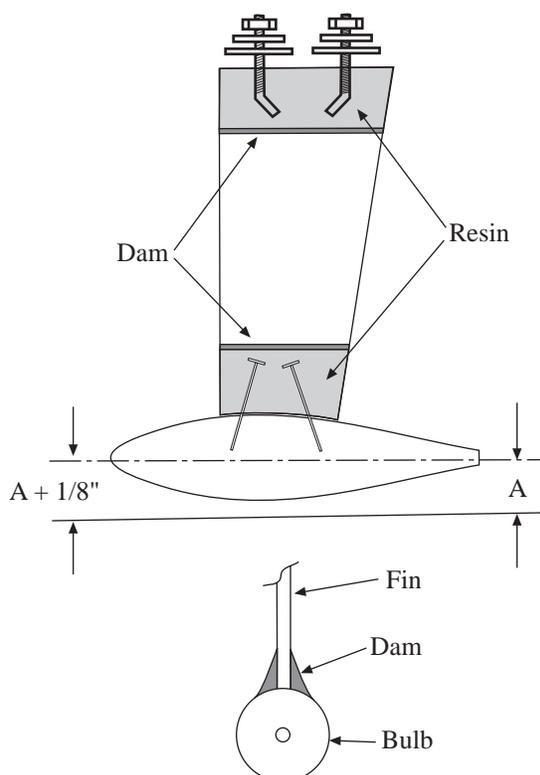
Clean off excess grease from fin and sand resin filler smooth. That's it...

ATTACHING BULB TO FIN

Drill two pilot holes in lead bulb at an angle, to a depth of 1/2". Drive nails into angled pilot holes and flatten nail heads. Leaving approximately 3/4" of nail exposed.



Slip keel blade down over nails. Some sanding will be required to fit the bottom of blade to top of lead bulb. the forward point of bulb should be elevated approximately 1/8" above aft end of bulb.



Using filler material (auto body surfacing putty), make a dam around base of blade and top of bulb. Pour approximately 1/2 oz. of epoxy or resin into top of keel blade to cover top of nails. Let epoxy or resin cure.

Make a dam at top of fin by cutting and shaping scrap balsa to fit into top of blade approximately 2" from top.

Cut and bend two 2" long 10-24 stainless steel machine screws and flatten heads. Place bolts approximately 1 1/2" into cavity. Use large nuts and washers to suspend bolts above top of keel. The amount of bolt above the keel is determined by the thickness of the keel mounting block in the hull.

Pour epoxy or resin into cavity and let cure.

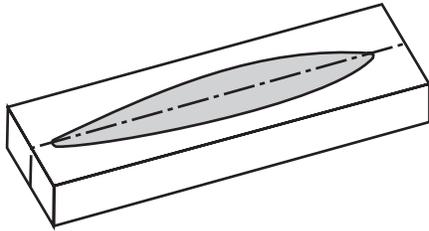
Sand and paint finished keel as desired.

LEAD BULB CASTING

We will explain two methods for casting a keel weight bulb. The 1st is lead shot and resin method, the 2nd is cast lead method. Both methods require a bulb pattern for making a mold.

Bulb Pattern

Fig 1. Tack (lightly) glue two blocks of 1"X 2"X 10"



(this will vary with bulb size) balsa wood together. A layer of thin cardboard lightly glued between the blocks makes splitting them apart much easier. The glue joint will be broken apart later.

Trace bulb outline on top of blocks. Whittle, carve and sand to this outline and finish to a torpedo shape. The bulb must be symmetrical in shape. The bulb can be turned on a lathe or electric drill motor. A coarse sandpaper block will take the block down to shape. When finished shaping, split the block apart along the glue seam.

Lead Shot and Resin Method

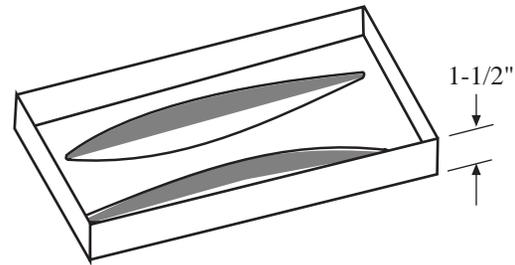
Fig. 2. Glue the pattern halves to a small panel of hardboard or plywood. Place 1 1/2" high sides around edge of panel. Use masking tape to hold box together and make it watertight.

Wax (floor, auto, any paste wax) all interior surfaces of box including bulb halves.

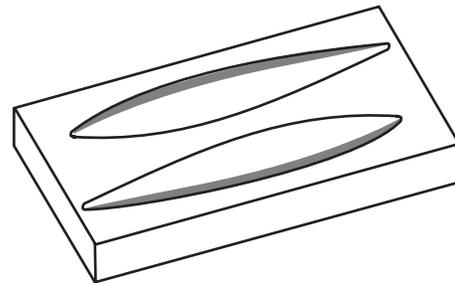
Mix a slurry of casting plaster and water. Make it like heavy cream. Pour slurry into box completely covering bulb halves. Fill to top of sides.

Fig. 3. When plaster has set, remove sides and bottom panel. You have a block of plaster with two concave recesses.

Let the plaster dry. This may take days, however, you



can speed up the process by using your kitchen oven. Three or four hours at 200 degrees F, maybe longer, should do the trick. Let plaster cool. Place plastic wrap (Saran, etc.) over plaster mold. This acts as a parting agent and allows the slugs to be removed from the mold easily.



Fill recesses with lead shot (the smaller, the better) and tamp lightly. Thin a quantity of resin (casting resin is best) with acetone. Be sure to catalyze. Pour the resin into the lead shot in both halves.

After the resin has cured, the bulb halves should pop out of the mold easily. Remove plastic wrap. If resin is tacky allow to set completely.

Use a file or sandpaper block to “true” the flat inner surfaces. Epoxy the two halves together. Hold in place with masking tape until epoxy has set and cured. Remove tape. There’s your bulb !

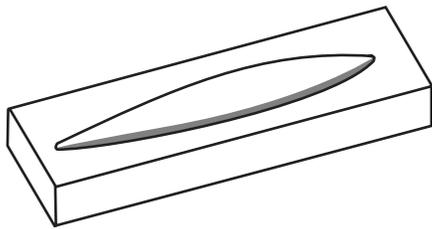
Poured Lead Method

Use the torpedo shaped bulb pattern to make your plaster mold. The intense heat of molten lead might shatter a double mold (as is shown for the shot and resin method) so we will make two individual molds. You only need one but it’s good to have some “insurance”.

Fig. 4. Follow the instructions for the Lead Shot and Resin Method for construction, waxing and pouring of the casting plaster, for both molds.

DANGER

The plaster molds must be absolutely dry before pouring lead. When molten lead is poured into the mold, the intense heat turns any moisture in the plaster into steam, which can explode the mold and splatter mol-



ten lead everywhere.

You can help the drying process by placing the molds in your kitchen oven for four hours at 200 degrees F.

Lead can be melted in an old frying pan. If you have an old cast iron frying pan (small), especially one with a spout, your in business. Your kitchen range or an electric hot plate will do for heat.

The lead should be clean, dry and in relatively small pieces. Start with a few pieces and when they start to melt, add more and the rest will melt rapidly. Impurities will rise to the top. Skim them off with an old spoon. The molten lead is ready to pour when a small wooden stick chars lightly when pressed into it.

Try to work out of doors during the melting and pouring process. Be careful when working with the molten lead.

Pour lead smoothly into the mold. Lead should be right up to the top of the mold. Pour the second bulb half.

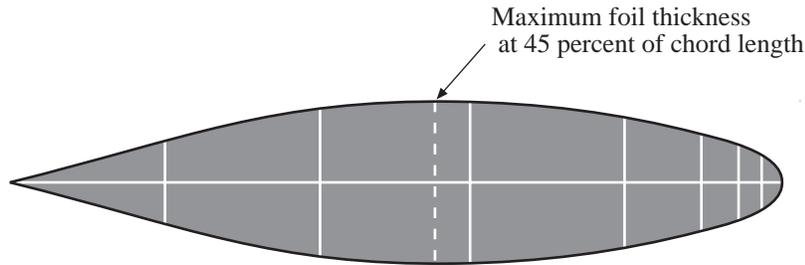
Let bulb halves cool, they retain heat for a long time. Be careful.

Pop halves out of mold. “True” flat inner surfaces with a file, epoxy halves together. Hold together with masking tape until epoxy has cured.

You may want to drill and countersink two holes through the bulb, for bolts and nuts. There’s your lead bulb!

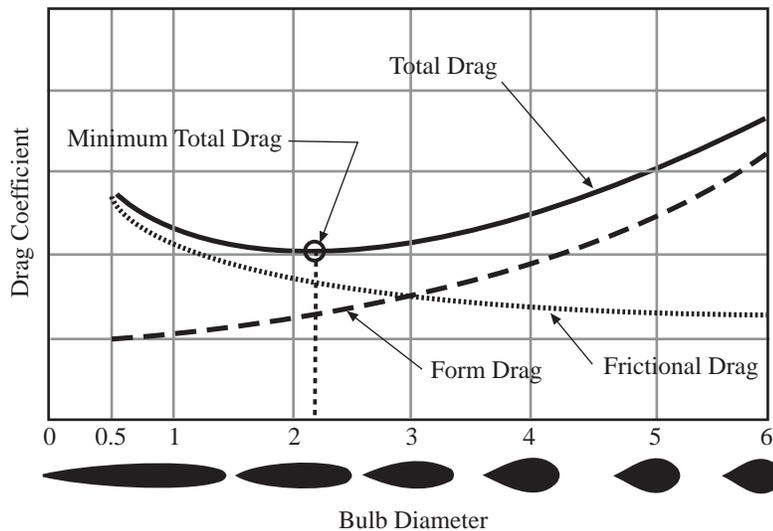
KEEL BULB SHAPE

By Dave Acree, Mesa MYC



Torpedo shaped keel bulbs do not provide lift, they simply help keep the boat upright. The goal in designing a keel bulb is to minimize drag. According to the U.S. National Advisory Committee for Aeronautics (NACA), if a bulb's volume of weight is constant, the size and length does make a difference. A long bulb with a small diameter produces a large wetted surface and high frictional drag, but is low in form drag. A bulb that is short and fat produces a small wetted surface and low frictional drag, but high in form drag. Both of these extremes will not give the performance a model yachter wants. The best performance is produced by a trade-off between chord length and thickness. Ideally, the maximum foil thickness of the bulb should be at 45 percent of the chord length. Note in the graph below that the point of minimum drag is lowest between 2 and 2.5. Anything before or after the 2 to 2.5 range creates more drag.

Drag vs. keel bulb diameter (where bulb volume is constant).



RUDDERS

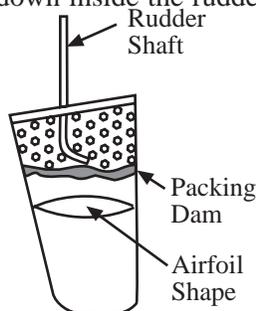
There are several methods for fabricating rudders. The basic square "skin" method. For rudders with curved shape, use shaped solid balsa wood covered with fiberglass and resin, or molded carbon fiber type. The installation of rudder to hull is the same for all types. The rudder should be placed as far aft as possible, without any part of the rudder extending past the hull. The method shown here is the "skin" type.

The "skin" type rudder is a light weight easy to construct rudder. The skin material can be 1/32" thick aircraft plywood, Formica, plastic sheet, or fiberglass resin lamination. The rudder shaft is 5/32" dia. rod either brass or hard aluminum.

Use the Fin and Rudder Jig, and instructions to build your basic shape.

Make the 5/32" dia. rudder shaft with a bend on one end. The bend prevents the rudder from turning on the shaft. You may have to file flats on the bent end, to allow it to slip into the rudder without bulging the sides.

Push cotton down inside the rudder to form a dam,



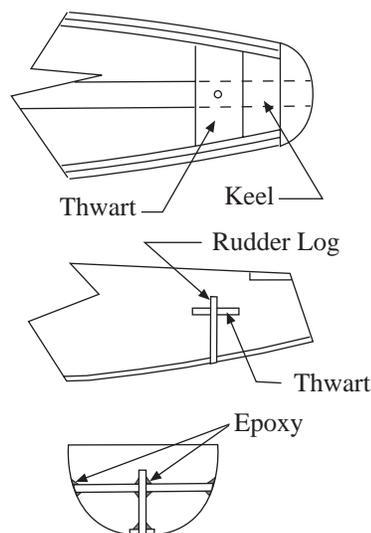
slightly below the rudder shaft. Align the shaft in the rudder so that it is at right angles to the water line of the hull, vertically straight with the rudder sides, also with about 60 % of the rudder area aft of the shaft. When it's in alignment tack glue it with Zap. Now you can fill the inside of the rudder with a filler of micro-balloons and resin or epoxy.

Zap or epoxy wooden end caps on the rudder and finish shape. The top cap can be used to get a good rudder/hull fit.

Finish off with a good water proof finish.

RUDDER LOG

The rudder log is a piece of 5/32" I.D. brass tubing located in the hull, that the rudder shaft slips into. The tubing must be long enough to extend through the keel, thwart (plywood brace), and above the waterline.



Locate the position of the rudder shaft. Drill a 3/16" hole through the keel and bottom of hull. This hole must be drilled at right angles to the waterline. Insert the correct length of 5/32" I.D. brass tubing through the hole, through the thwart extending above the waterline. Be sure

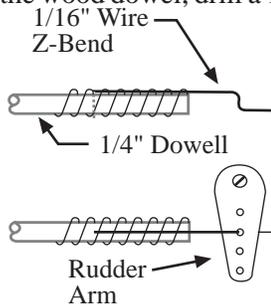
the rudder log is vertical and at right angles to the waterline. Tack glue with Zap, check alignment. Alignment is easier if you insert a long length of 5/32" music wire, rod or tubing in the rudder log while "eye balling" the alignment. Glue it all with micro-balloons and Zap or epoxy.

PUSHRODS

The rudder pushrod connects between the rudder servo and the tiller arm (use a model airplane steering arm). The pushrod must be very stiff, no deflection or flexing. The end connections to the servo arm and tiller arm can be made from 1/16" music wire with a "Z" bend. Or a model airplane clevis and threaded clevis wire. The good thing about the clevis is it's adjustable, which makes adjusting the centering of the rudder easy.

Between the two ends is a stiff piece of material, the material can be a 1/4" wood dowel, carbon fiber tubing or aluminum arrow shaft.

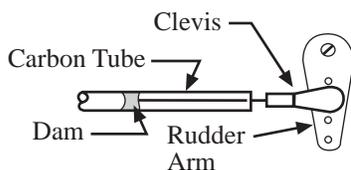
If you use the wood dowel, drill a 1/16" hole through



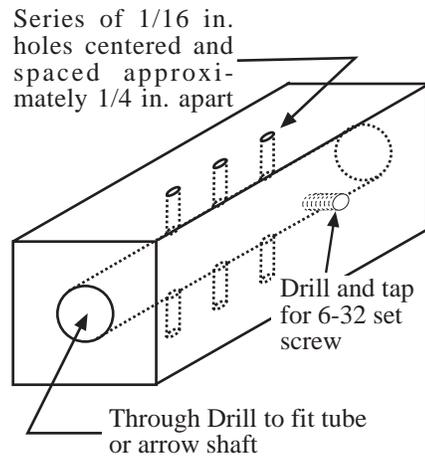
the dowel about 1" from the end. The "Z" bend or clevis should extend past the end of the dowel far enough so there is no binding, with full rudder throw. Cut the wire to length allowing for 1/4" right angle bend. Insert the 1/4" bend in the 1/16" hole in the dowel. Wrap the wire and dowel with string, then Zap it. Do both ends of dowel.

If you use the carbon fiber tube or arrow shaft, stuff a cotton dam down the tube about 1" from end. Make a small right angle bend at end of wire. Clean the end of the wire that will be in the tube, with sandpaper. Center wire in tube and layer in micro-balloons and Zap.

That's it for the pushrod.

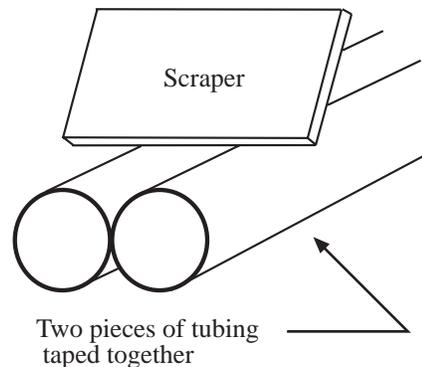


ARROWSHAFT DRILLING JIG



A through drilled piece of 3/4 inch square aluminum stock approximately two inches long makes a great jig for drilling arrow shafts and other tubing. Size the through hole to match the O.D. of the shaft. A 6-32 set screw lock everything in place for drilling. One person I know made one of these jigs from oak — minus the set screw, and it seems to work fine.

SCRIBING TUBING

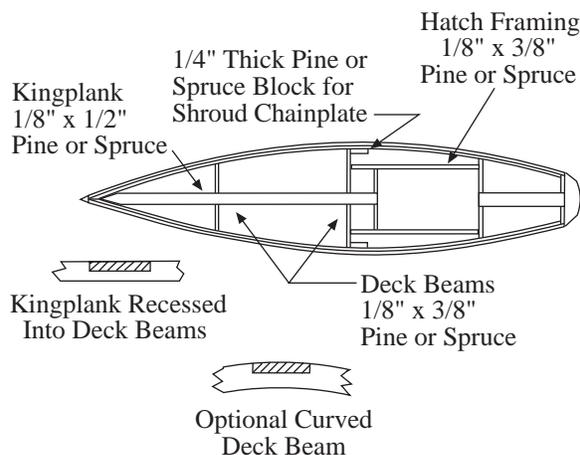


To scribe a straight line along a metal tube or aluminum arrow shaft, simply tape two identical pieces of tubing together and scribe the line with any handy piece of sheet metal with a straight edge. --Hal Robinson, Minuteman MYC, Massachusetts

DECKS AND HATCHES

SOFT DECK

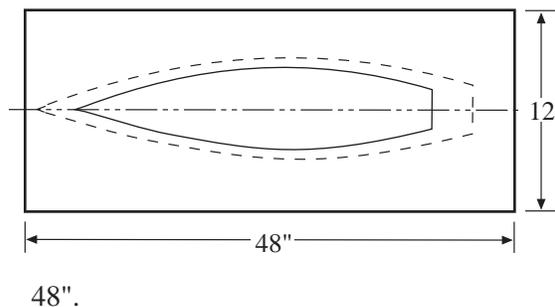
The “soft deck” covering material is “Solar-Tex, Monocoat, Micafilm” or other similar heat shrink type model aircraft covering material. “Micafilm” has a fabric weave to it, which gives it more strength than the other “film” type covering materials. Follow the instruction that come with the covering material. The edges of the material should be sealed with 1/4" wide auto stripping tape. Half the width of the tape on the fabric and half on the hull.



Deck beams can be flat which gives a flat deck, or curved so the deck is crowned. Deck beams should be located at the jib pivot, near the sheet exit guides and the mast.

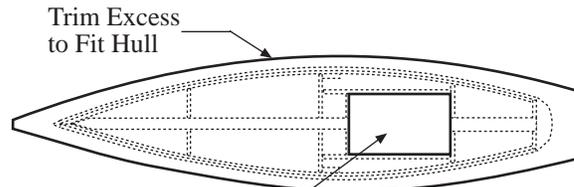
PLYWOOD DECK

The deck support arrangement for a plywood deck is the same as the “Soft Deck” arrangement. A flat deck is easier to cover with plywood than a curved deck. The deck is made from 1/32" thick aircraft plywood. It is available from the hobby shop in sheets of 12" x



48".

Place the hull on plywood, deck side down. Trace around deck edge with a pencil. Cut about 3/8" outside of pencil line. This excess will be trimmed later.



Lay out a ~~Hatch Cutout~~ Hatch Cutout under size hatch opening. It will be trimmed and sanded to size later.

Carefully sand all hull surfaces that come in contact with under side of deck.

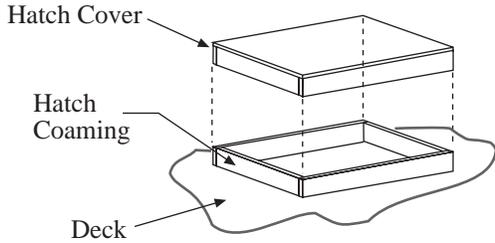
Apply epoxy to all hull surfaces that will come in contact with underside of deck. Place deck in position. Use strips of masking tape to hold deck in position. Use lots of tape! Small “C” clamps or clothes pins around the hatch opening

work well. Let epoxy cure, trim deck edge and hatch opening. Sand and finish.

HATCH COAMING AND COVER

The hatch coaming is made from 1/16" plywood strips. They are epoxied inside the hatch opening framing and should extend approximately 3/8" above deck.

The hatch cover is made from 1/32" plywood. It must

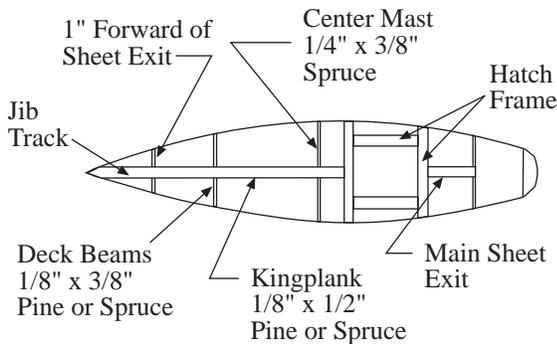


be a tight fit to prevent water from getting into the interior of hull.

Place a small sheet of plastic wrap (Saran Wrap or similar) over hatch coaming and build hatch cover frame around coaming. Glue a sheet of 1/32" plywood on frame. Trim and sand.

MORE SOFT DECK

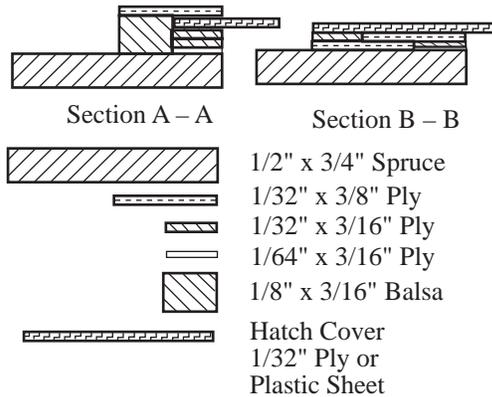
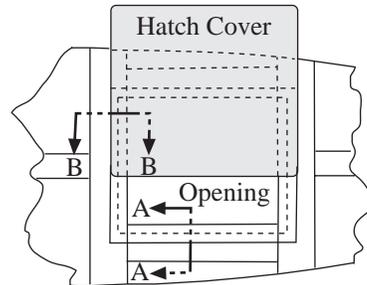
The actual positions of the jib track, jib sheet exit guide, mast step, hatch, and main exit guide is determined by the design of the hull, fin, sail plan, and sail



control unit. Place the deck beams across the hull from gunwale to gunwale, under areas of the kingplank that will be subject to compression or strain.

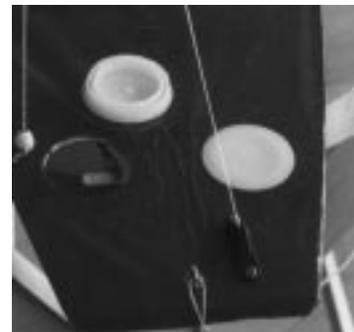
SLIDING HATCH

This hatch cover slides out from the side of the hull and has tongue and groove rails for sealing.



MILK BOTTLE CAPS

Milk bottle caps make great hatches in places where you don't need constant access. The frame is made by cutting a hole in 1/16" plywood with a 1-3/8" hole saw. It's a good idea to seal the hatch with petroleum jelly.



MASTS

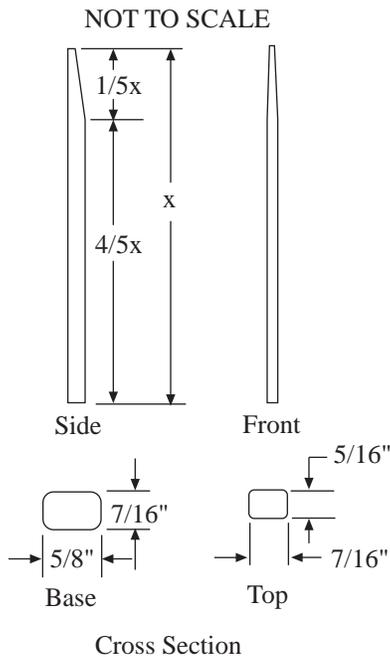
Mast blanks are available from several suppliers or you can make your own.

Masts can be made from:

- Carbon fiber mast blanks.
- Carbon fiber fishing pole blanks.
- Carbon fiber cross country ski poles.
- Fiber glass fishing pole blanks.
- Aluminum (extruded) blanks.
- Aluminum tubing (1/2" dia. thin wall)
- Wood: Spruce, Pine (molding), Etc.

A wooden mast is the least expensive. It works well for a short rig.

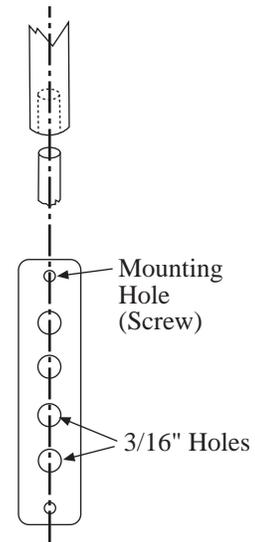
Taper the front and sides with a plane (small block plane) and sand to approximate dimensions shown in the cross section drawing.



Finish with resin or varnish. Drill a 3/16" hole in base of mast. If you are using a hollow mast, epoxy a short dowel in mast base. Drill hole in base of plug.

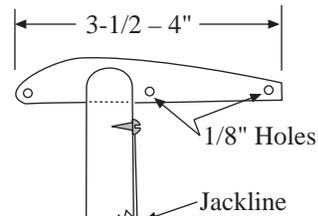
Epoxy a short length of 3/16" dowel in hole. Leave approximately 1/8" exposed. The exposed dowel will mate with mast mounting plate on deck. An alternate method would use a short length of 1/8" dia. stainless rod, with correct size hole.

Mast deck plate can be made of 1/8" thick plywood, aluminum, plastic or any hard material.



The masthead crane is made from 1/16" thick sheet aluminum, brass or fiberglass.

Cut a slot in top of mast to receive crane. Epoxy in

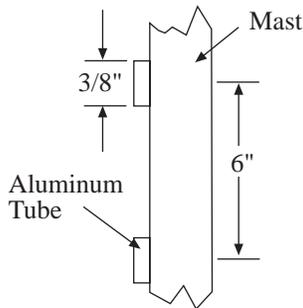


place. To help secure the crane in place, epoxy a steel pin or screw through mast and crane.

There are several methods for attaching the luff of the mainsail to the mast. Two are shown, jackline and mast loop.

Jackline method:

Short sections of 1/16" I.D. aluminum tubing will be epoxied along back side (trailing edge) of mast at 6" intervals. Determine number of tube sections required. Cut tubing with small file or razor saw. Debur edges.

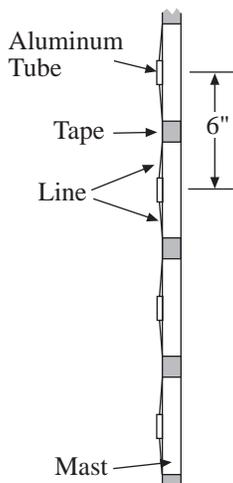


Thread tubes on a length of line (heavy fish line). Stretch line along trailing edge of mast. Secure ends of line with masking tape.

Wrap masking tape around line and mast between tubes.

Epoxy (or Zap and micro-balloons) tubes to mast. Allow epoxy to cure.

Remove tape and line. Stretch a jackline through tubes. Use stainless steel wire or plastic coated braided stainless steel leader material (available at fishing tackle shops). Use small sheet metal screws

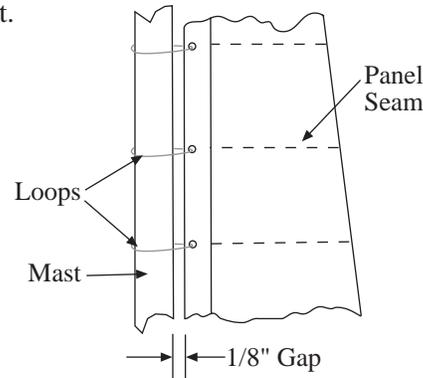


to anchor jackline ends. A drop of epoxy placed in screw hole will keep screw from working out.

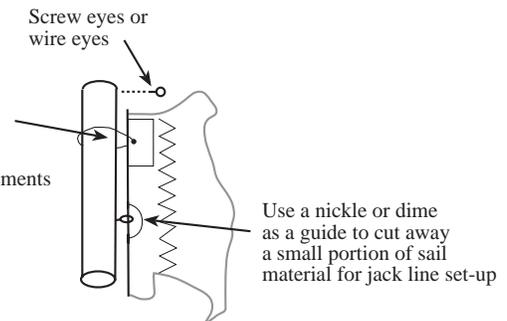
Mast loop method:

Loosely tie the main luff to the mast, using light weight line.

At every horizontal sail panel seam, make a small hole in the luff about 1/8" from the leading edge (if sail material is Mylar melt a hole with a small round tip soldering iron, the melted material acts like a grommet. If sail material is fabric you need a grommet to reinforce the hole.). Tie the sail to the mast with loops of line through the luff hole and around the mast, leaving a 1/8" gap between the luff and the mast.



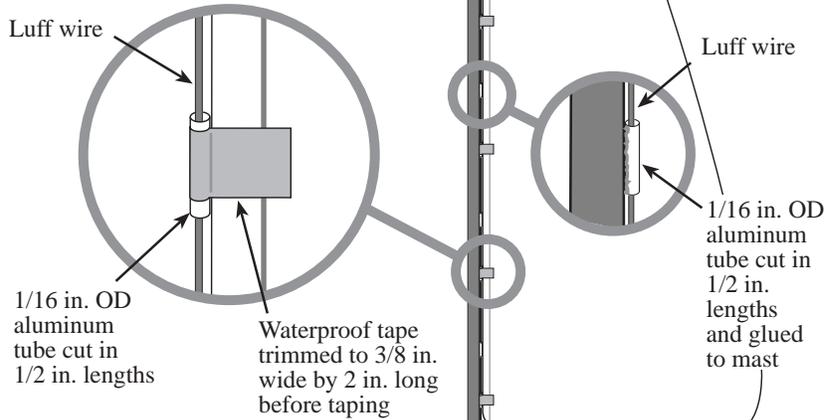
Jack line runs from the mast head down to the gooseneck through small wire or screw eyes or use the small tied loop method w/small reinforcements made from sail repair tape cut in 1/2" X 1/2" squares



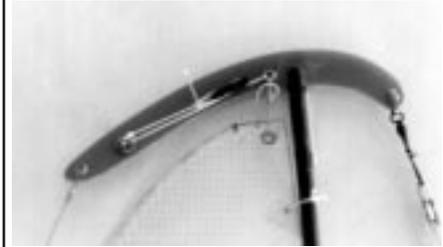
Two different ways to attach the main sail to the mast.

Here's a simple and effective way to attach the mainsail to the luff wire without cutting notches in your sails. I've used this system for two seasons now, and it hasn't let go once. Simply tape 1/2 inch lengths of 1/16 inch OD aluminum tubing to the luff of the sail using waterproof tape trimmed to fit. I use Bruline "Radio Box Tape," but Greg Jarvis (my sailmaker buddy) says standard plastic packing tape will work just as well.

—Jim Linville
Minuteman MYC

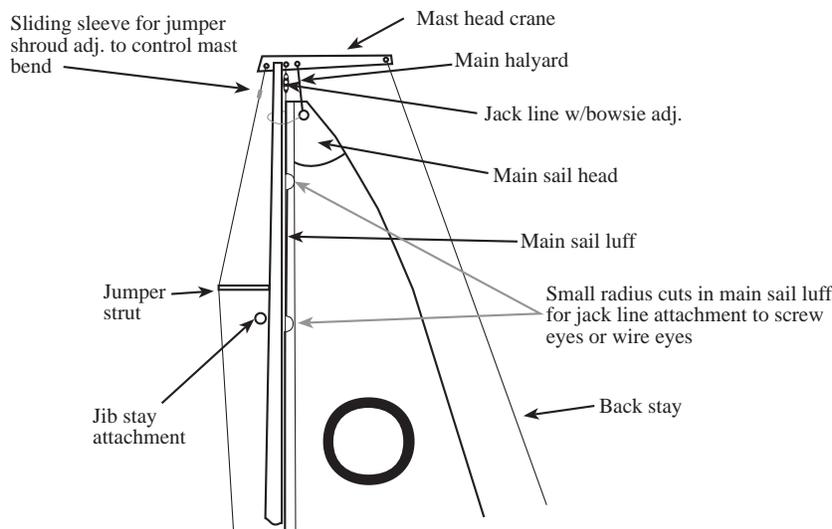


MAST HEAD CRANE

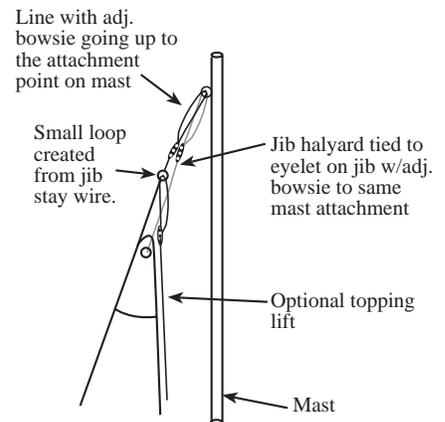


This arrangement uses an up haul on the mast head crane instead of a down haul on the gooseneck to control the main sail luff tension.

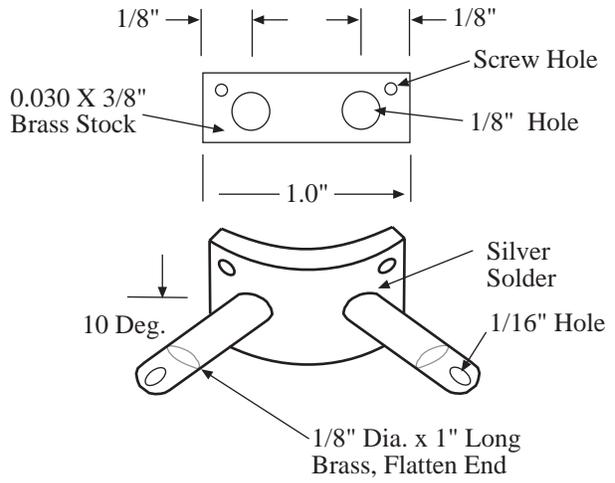
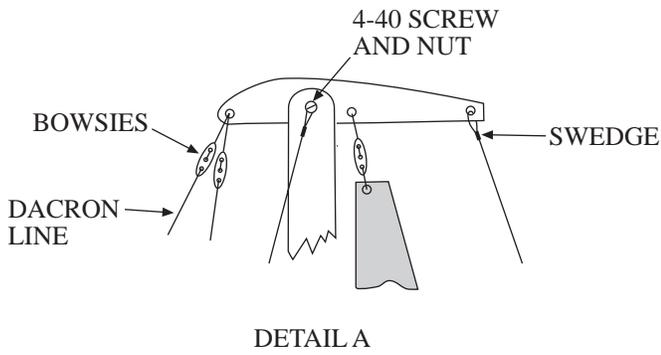
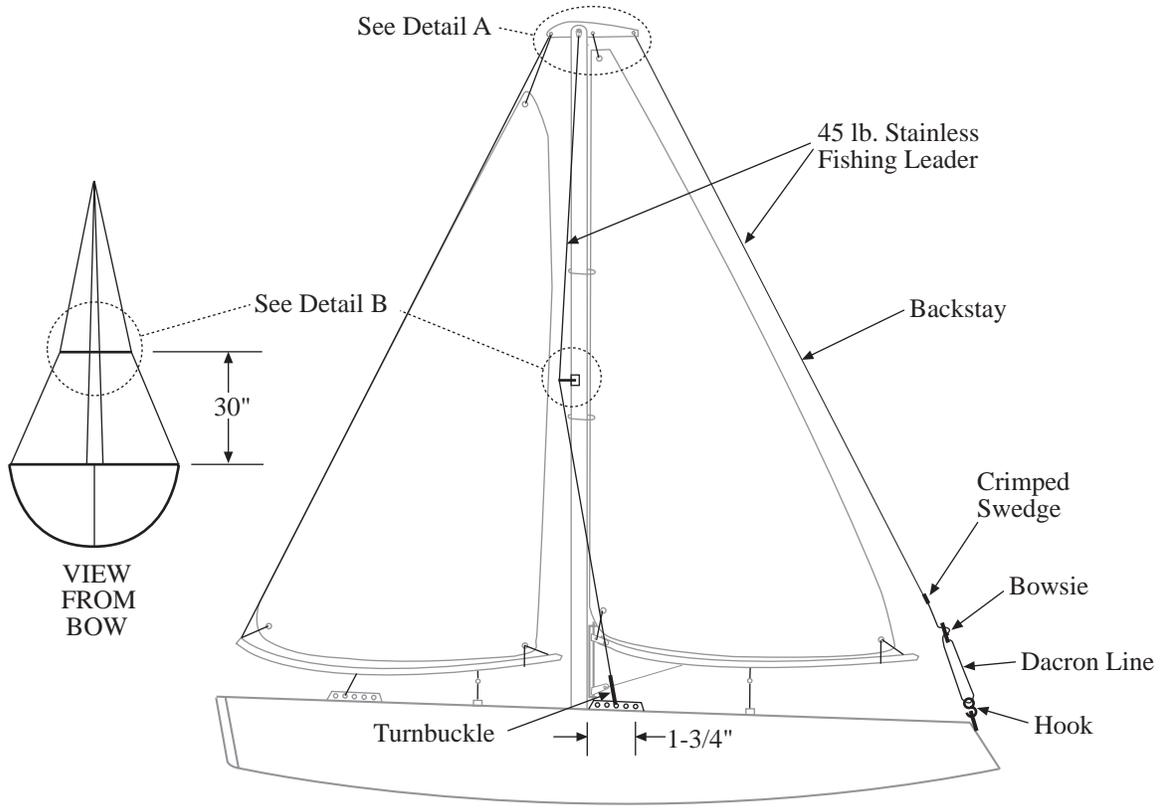
RUNNING RIGGING



Mast head rigging of a typical fractional rig



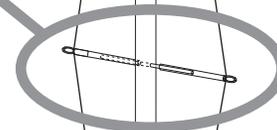
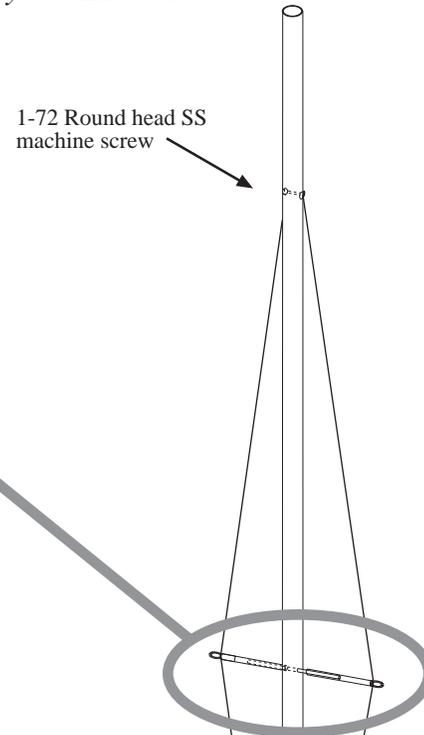
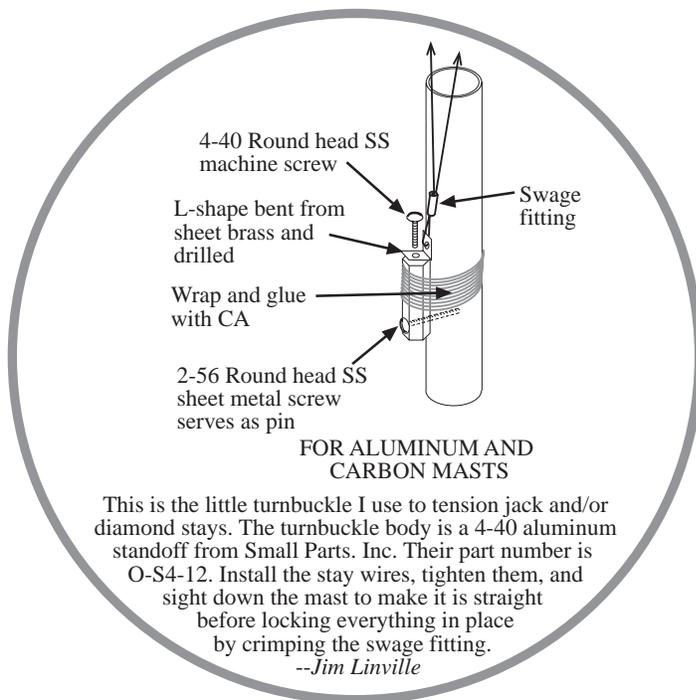
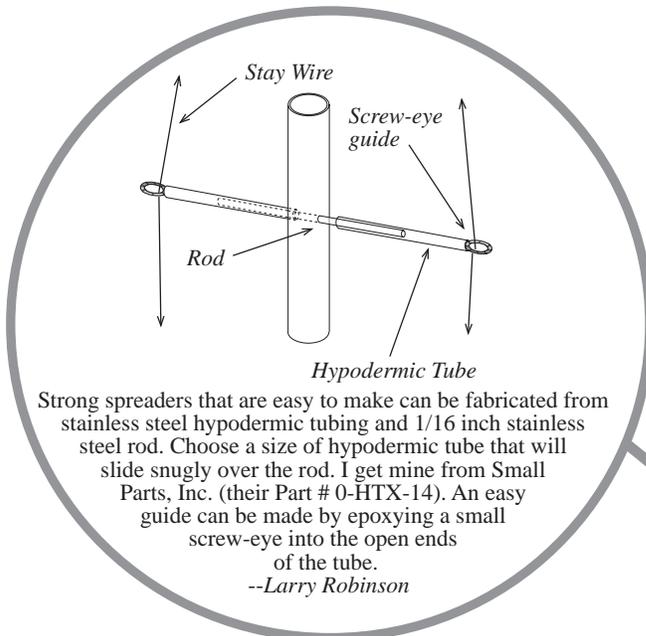
Attaching the jib to the mast on a fractional rig..



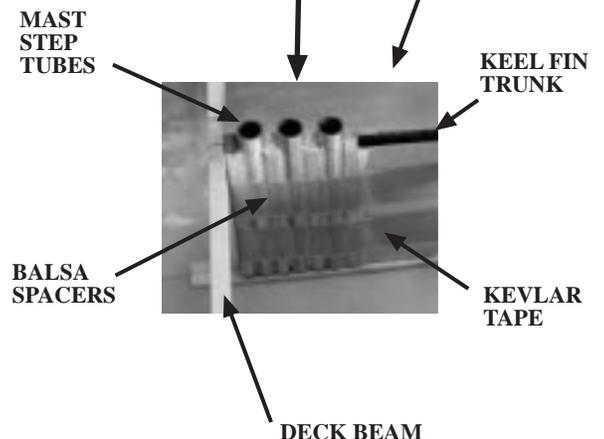
DETAIL B

MAKING A MAST FROM A CARBON FIBER KITE SPAR

By Jim Linville



I use a series of aluminum tubes spaced out with balsa strips, glued with CA, and wrapped with kevlar tape. A typical assembly looks like this.



I use ProSpar PS-19-352 carbon fiber kite spars for US1M masts. The PS-19-352 is a tick under 3/8 inches in diameter, and a 65 inch mast weighs in at slightly less than 2 oz. They're available from almost any serious kite store.

The PS-19-352 only comes in 53.5 inch lengths, so they have to be spliced. I find that the Dave Brown 1/4 inch fiberglass push rods from Tower Hobbies fit nicely and make great splices. You can also buy splicing pieces from the spar manufacturer. I like the Dave Brown push rods because they can be used as reinforcing sleeves to help control mast bend.

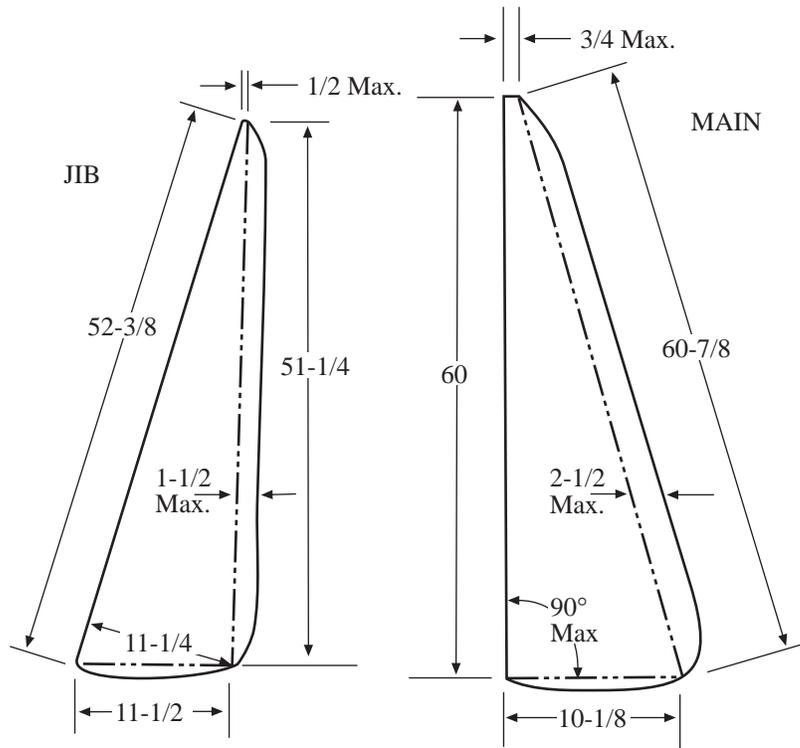
While they're surprisingly stiff for a 2-ounce spar, they still need side stays, but a long diamond stay will also work if you just have to keep the mast free standing. I do, and I use a diamond stay that stretches approximately 80 percent of the mast length.

7/16 inch K & B aluminum tubing makes great mast stepping tubes.

SAILS

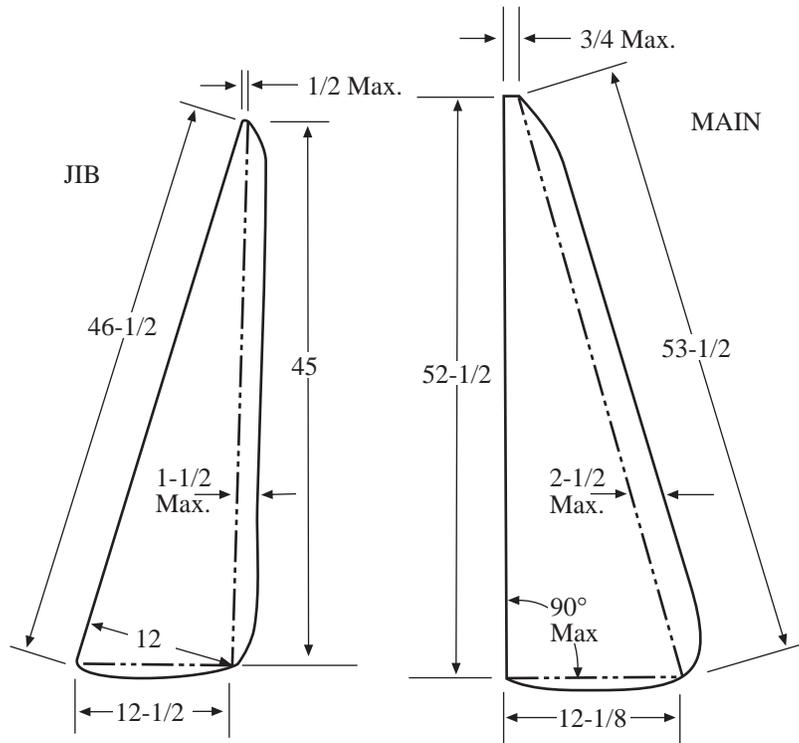
60" LUFF FOR WINDS BELOW 5 MPH
(All dimensions in inches)

Sail Area
Main = 303.75
Jib = 294.60
Total = 598.35



52" LUFF FOR WINDS ABOVE 5 MPH
(All dimensions in inches)

Sail Area
Main = 318.28
Jib = 279.00
Total = 597.28



MAST SUPPORTS

The method used to attach the keel to the hull, the size of the radio board, and the type of sail control are the major factors that determine the type of mast support that can be used on a U.S. One Meter.

Masts can be stepped on the deck and supported with shrouds. Or stepped through the deck in a tube, with this arrangement they may not have shrouds.

Options for supporting deck-stepped masts include:

- Full height fin trunks which can provide bracing between the keelson and the king plank as well as a strong method for keel attachment.
- Extra thick deck beams which can be used with fractional height fin trunk so there is clearance under the deck for rotation of a sail winch arm.
- Separate mast support piece between the keelson and the king plank for use with bolt-on keels.

Through deck stepped masts include:

- Stiff carbon fiber masts can be used with or without shrouds. Without shrouds, these masts are stepped through the deck to the keelson via a mast tube. The mast tube has an inside diameter that closely matches the outside diameter of the mast butt. Shims can be placed in the tube (around the mast) to adjust the rake or lean of the rig. A tube is usually made of glass reinforced plastic, and is glued in place upon the keelson and to the deck support so that water does not leak into the hull. Remember a mast stepped in this manner can not be moved fore and aft. To balance the boat, the tube may have to be moved or the proportion of the areas of the main and jib may have to be changed.

Here's an example of Hal Robinson's mast support installed in a hull. Details on the next page.



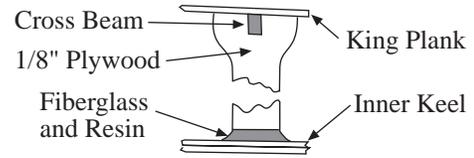
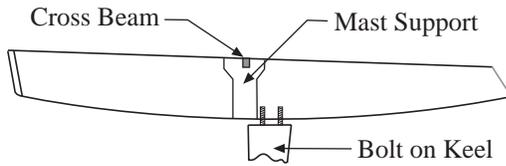
MAST SUPPORT FOR BOATS WITH BOLT ON KEEL

The mast support is made from 1/8" thick aircraft plywood. Shape is determined by radio board installation.

Install sturdy (3/16" x 1/4" pine) cross beam at the mast location.

Cut and fit mast support between king plank and inner keel

Epoxy at king plank, fiberglass and resin at inner keel.



BOOMS

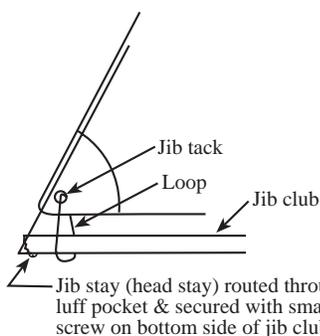
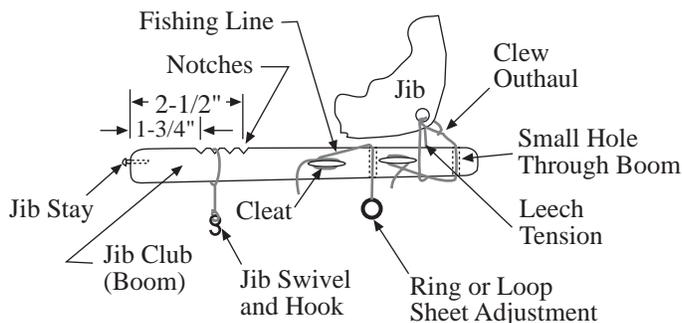
Booms should be stiff and light weight. Weight is important factor, particularly the jib boom. The jib boom rotates around a forestay which is far from being vertical. As the boom rotates outward the tip of the boom has to lift upward. The heavier the boom the more wind force required to swing the boom out. The main boom rotates around a vertical mast and does not have the lifting problem. They can be any shape, so long as they meet the class rule.

Booms are made from the following materials:

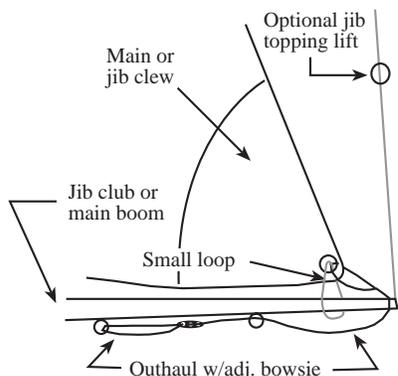
- Carbon fiber tubing (arrow shaft).
- Aluminum tubing (arrow shaft).
- Carbon fiber/foam composite flat stock.
- Wood.

The drawing above right is a wood jib boom.

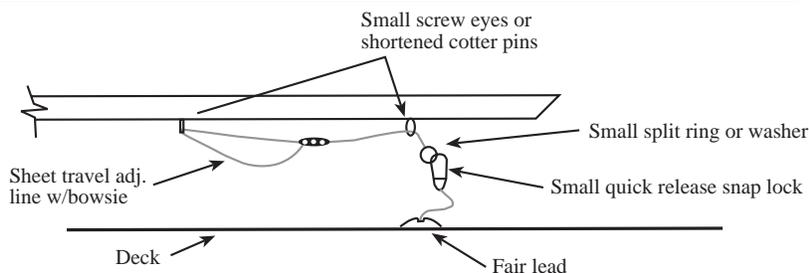
The hardware and rigging is a general arrangement. You may need to change some of it too fit your needs.



Rigging the tack end of a jib club.



Rigging the clew of a typical main boom or jib club.



Sheet adjustment rigging for a typical main boom or jib club.

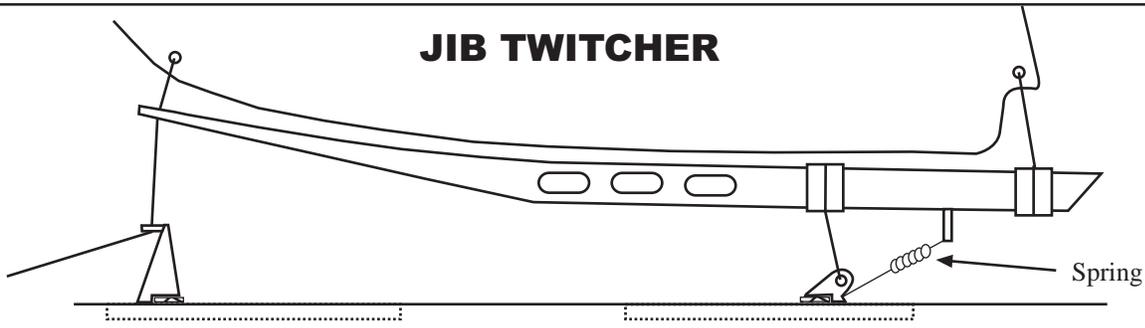
ARROW SHAFTS

JIB SWIVEL

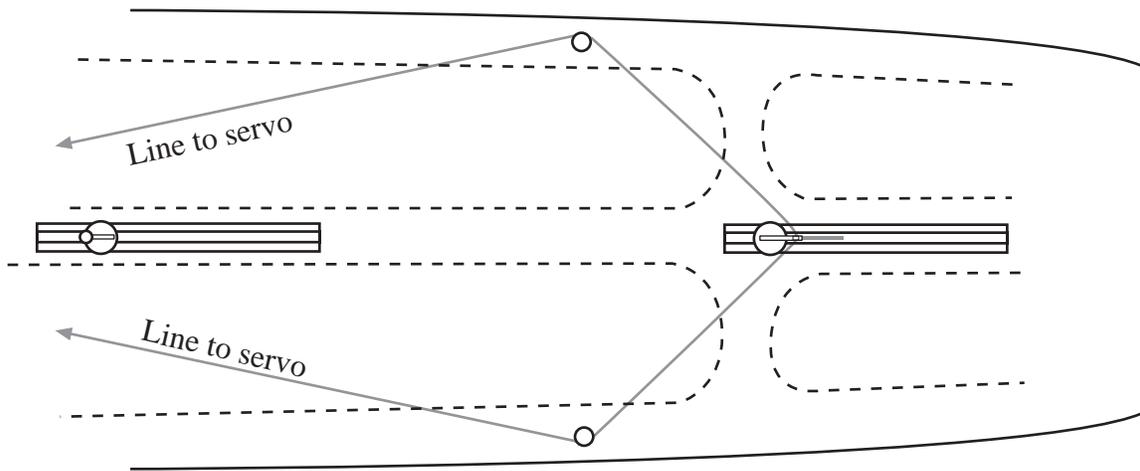
OUTHAUL

Small aluminum arrow shafts or carbon fiber tubes make excellent booms for US One Meters. Most sporting goods stores carry aluminum arrow shafts, and carbon fiber tubes are available from hobby shops and kite stores. You can get the rubber grommets at Radio Shack.
 — Dave Acree, Mesa MYC, Arizona

JIB TWITCHER

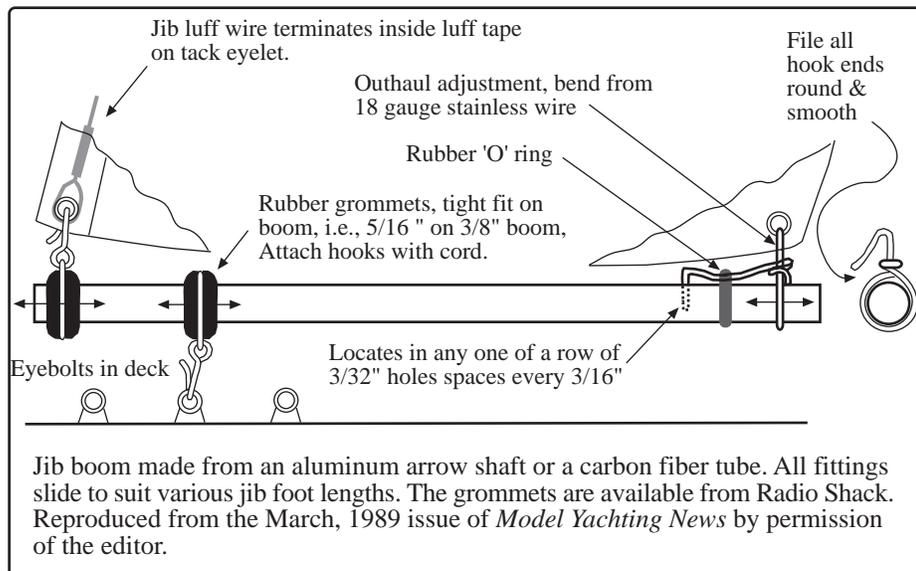


Jib boom is tapered (cut) and angled upwards behind the swivel point to help it move more easily in light winds and to avoid the boom end hitting the water on a reach. Make all fittings on this boom aft of the swivel point as light as possible. A counter weight can be fitted to the forward end of the boom.



JIB TWITCHER

A servo operates the line which is attached to the bottom end of a spring located forward of the pivot point. As the line moves, the spring centerpoint is moved to one side or the other, forcing the jib boom to move with it, and "goosewing" the jib. Easy to rig, overdeck mounted, and easy to adjust.

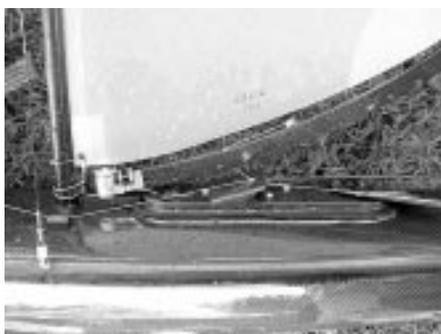
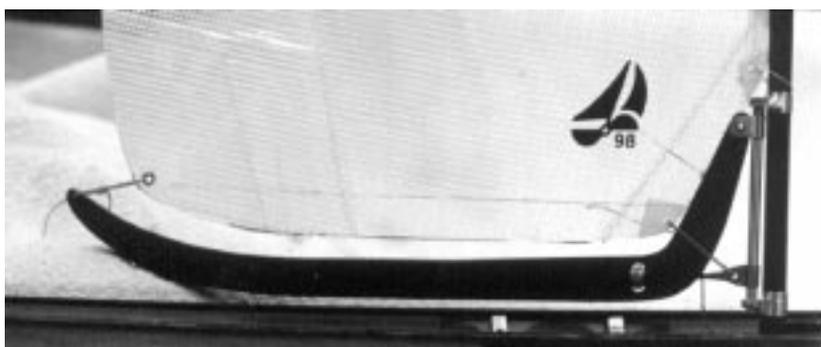


Jib boom made from an aluminum arrow shaft or a carbon fiber tube. All fittings slide to suit various jib foot lengths. The grommets are available from Radio Shack. Reproduced from the March, 1989 issue of *Model Yachting News* by permission of the editor.

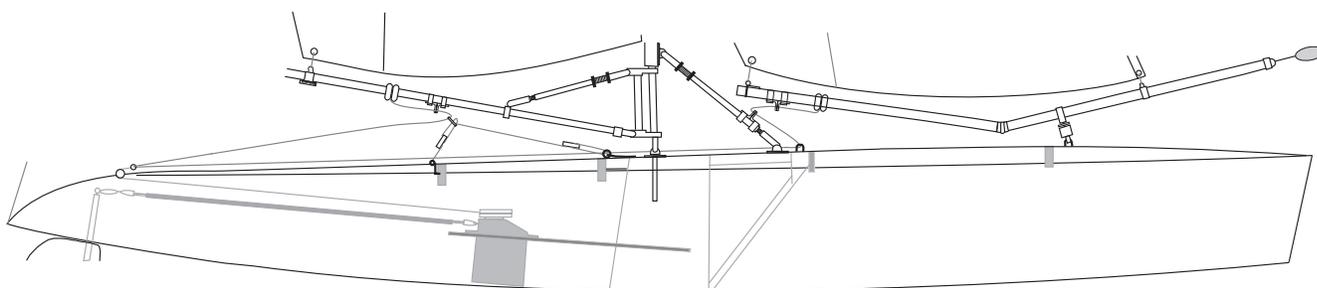
ARROW SHAFT BOOM



This is the end of one of Hal Robinson's booms. Hal makes them from aluminum arrow shafts that he heats with a torch until the aluminum begins to change color. He then lets them cool slowly to room temperature before bending curves to match the foot of his sails. After bending, the shaft is flattened between two boards in a vice. Hal says he has to overbend the curve because some of it will come out during the flattening procedure. Note the neat use of a cotter pin as a strap eye.

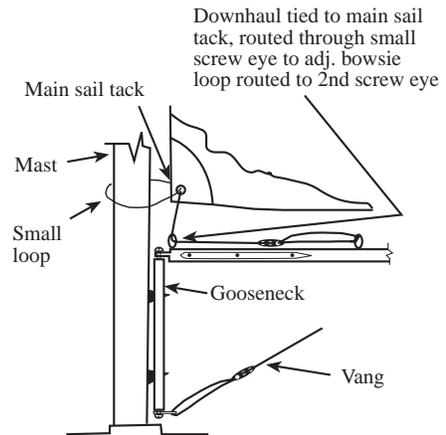
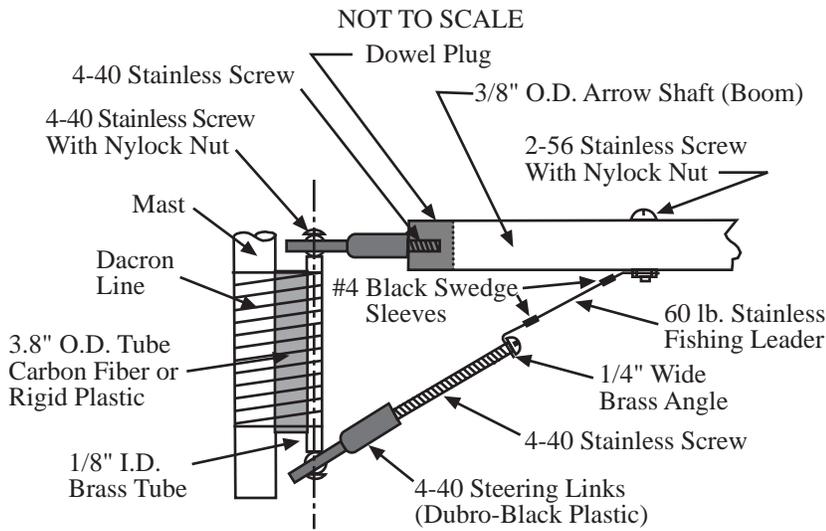


Here are a couple of innovative gooseneck/main boom designs. Top is Hal Robinson's "Dog Sled" boom. Its intent is to get the foot of the sail as close to the deck as possible in order to reduce "wing tip drag." Bottom is Swede Johnson's "Offset" boom. Its purpose is to help control sail shape by acting much like a vang while the boom is sheeted in tight and then forcing "belly" into the sail when the boom is sheeted out.



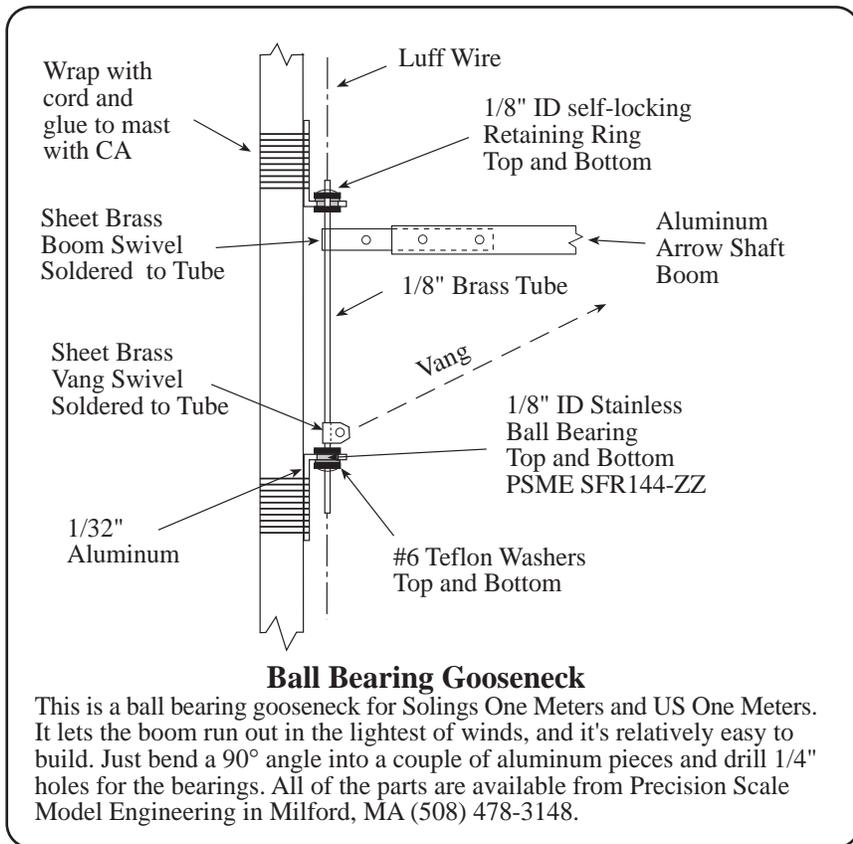
This spiffy "conventional" rig is adapted from a drawing in the September 1989 issue of Model Yachting News, and is reproduced here with permission of the editor.

FITTINGS



Rigging a downhaul and gooseneck

GOOSENECKS



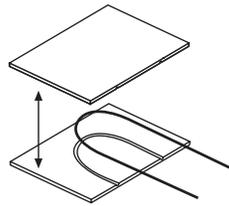
HOMEMADE "TURNING BLOCKS"

By Jim Linville, US One Meter Class Secretary

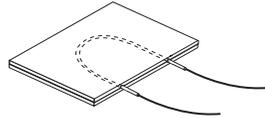
Here's a quick and easy way to make blocks for pennies. I feel they are as good, if not better than, the expensive imported ball bearing type. The teflon tubing comes from Small Parts, Inc. in Miami Lakes, FL and costs \$2-3 for a 10 ft length. Their part number is SWTT-16.



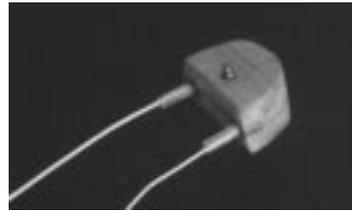
Bend a piece of wire or rod into the shape you need (coat hangers work nicely).



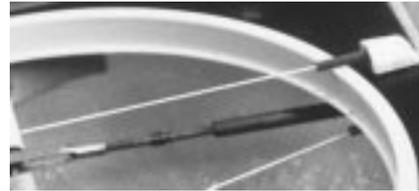
Place the wire shape between two pieces of 1/8 inch balsa and press together to form an indent in the balsa.



Line the indent with Teflon tubing and glue the two pieces of balsa together with slow CA.



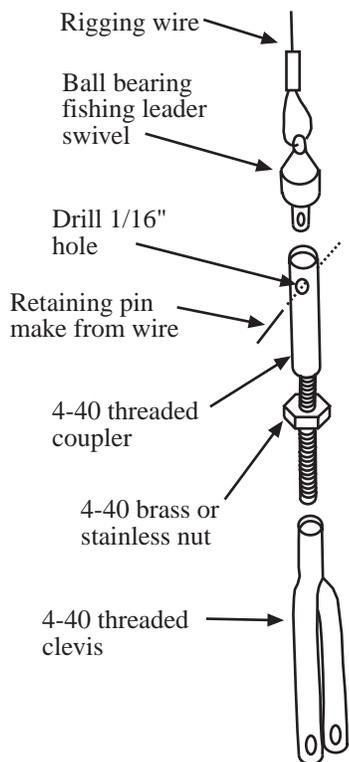
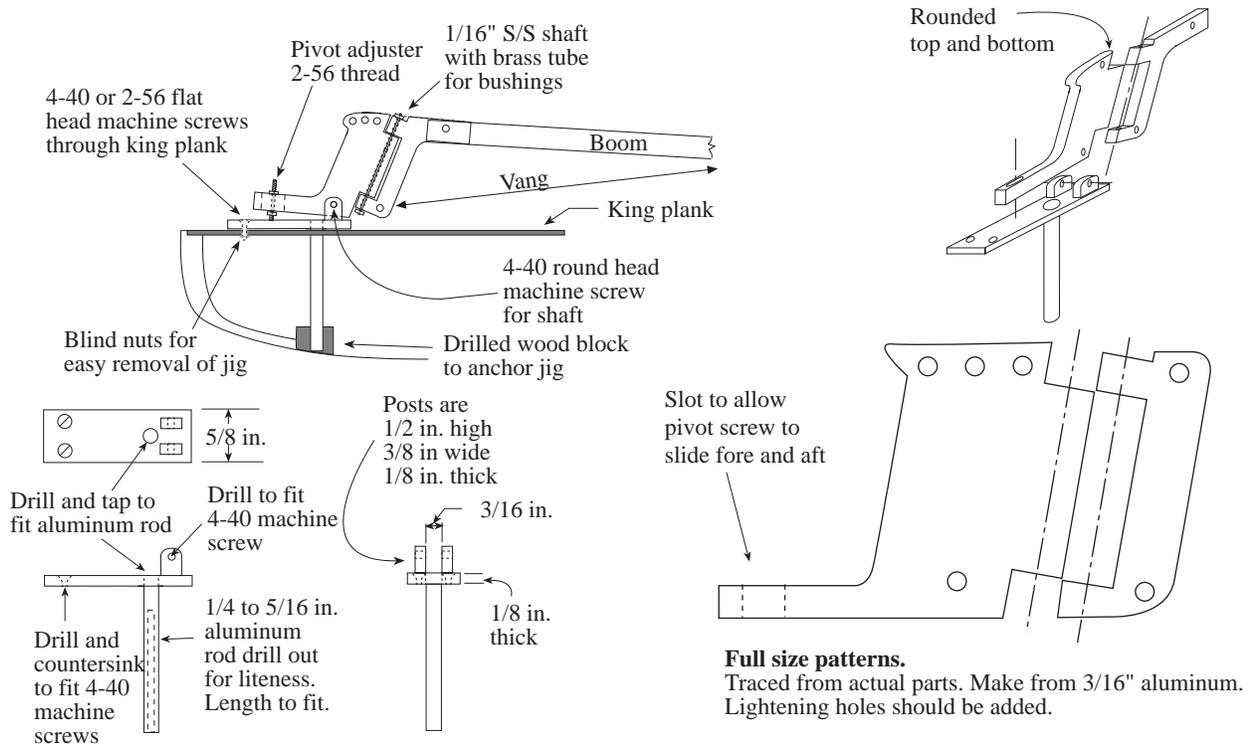
After trimming, the finished block will look something like this.



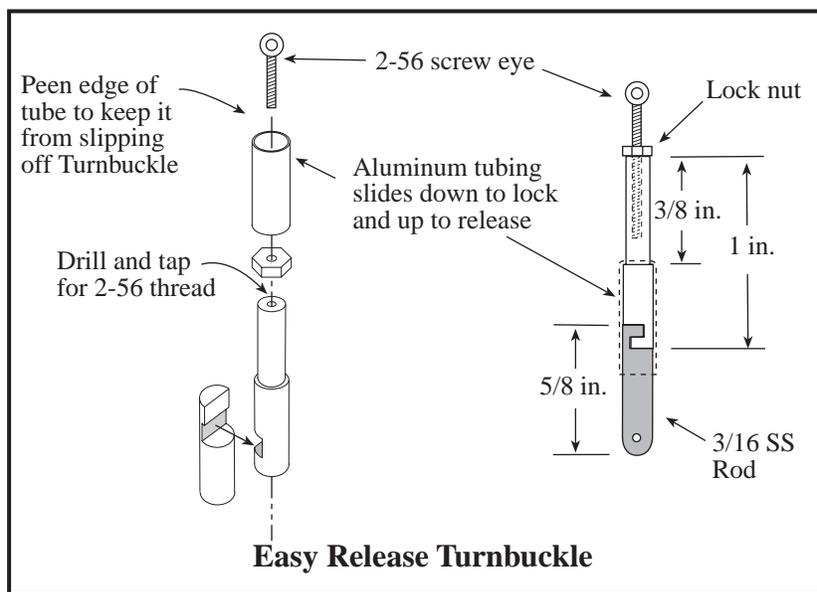
An example, here the block is being used for thru-deck sheeting on one of Hal Robinson's boats.

Manny's Radial Jib Fitting.

This is the radial jib fitting used by Manny Costa on three of his National Champion Stars and an EC 12. It could probably be lightened considerably for use on a One Meter. **To Set-up on boat.** With sails bent on, (1) swing boom to full out position and use vang to bring boom perpendicular to mast, and (2) adjust pivot adjuster screw to bring boom parallel to deck,

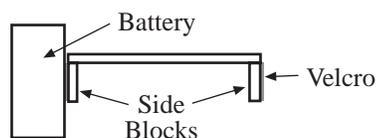
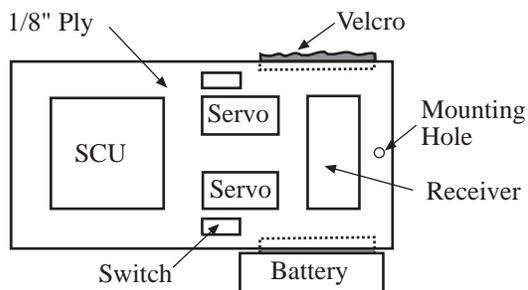


TURNBUCKLES



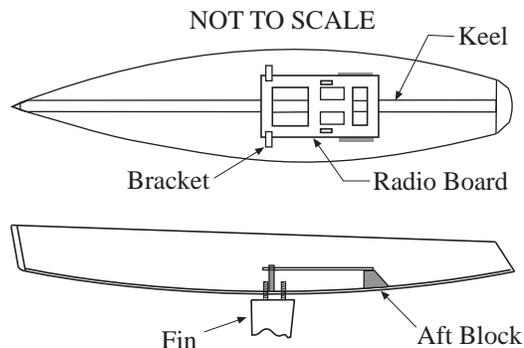
Here's a simple turnbuckle from Art lent of Florida's Space Coast Model Sailing Club.

RADIO BOARD

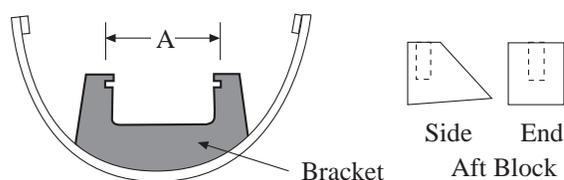


This is a typical radio board. The radio board is often called a sail control unit (SCU) board. Change dimensions, type of components and placement of components to fit your equipment. The radio board is best installed before the deck is applied. Be sure the board can be easily installed and removed 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

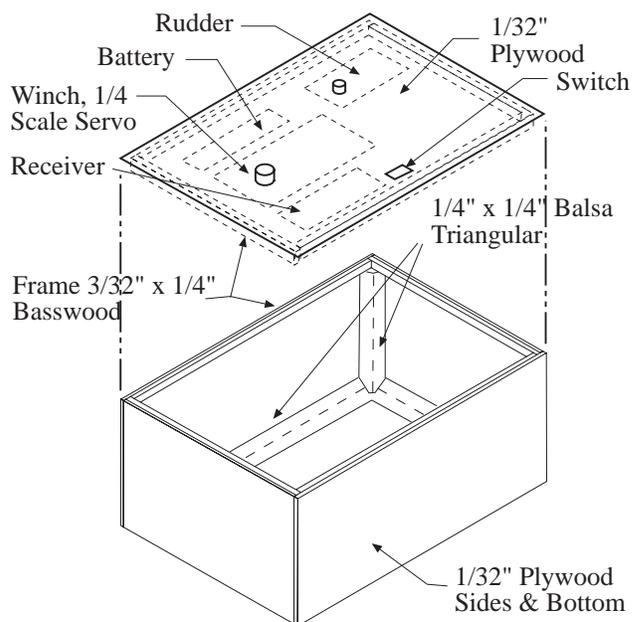
If you sail in saltwater or rough water, the radio box will provide better corrosion protection for your radio gear, than a radio board.

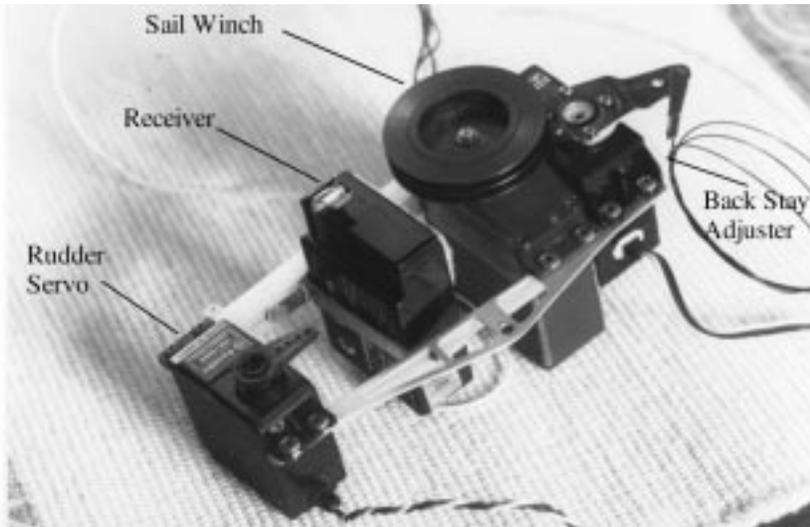
Size the box to fit your equipment. To construct the box, build two frames, the cover frame should be a snug fit inside the box frame. The sides, top and bottom are 1/32" thick aircraft plywood. The box corner joints

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

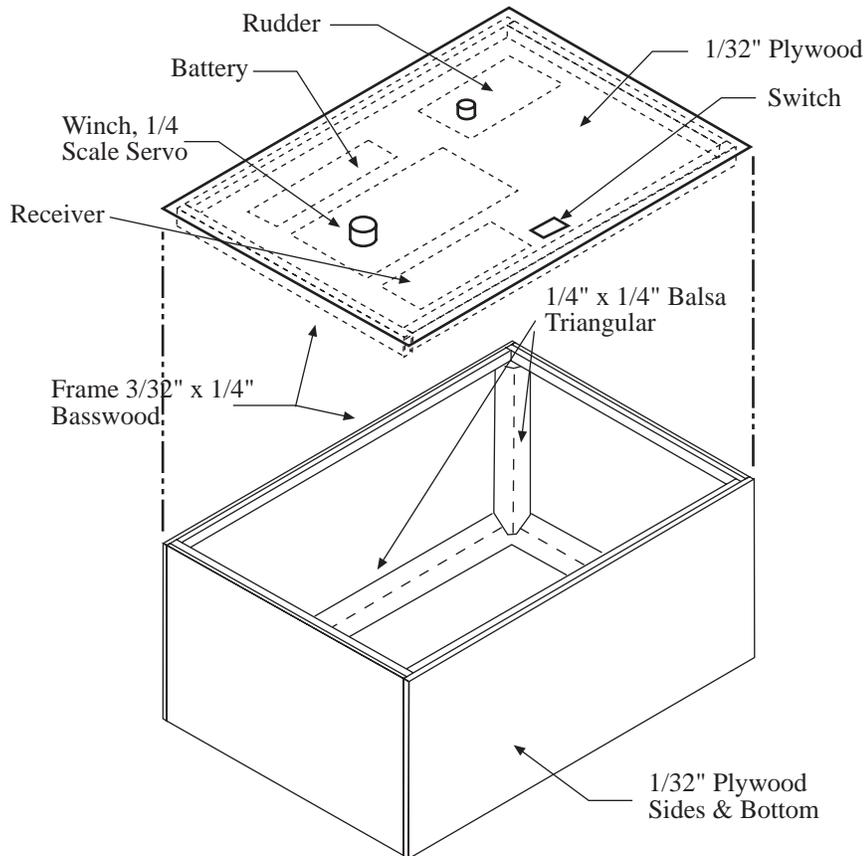
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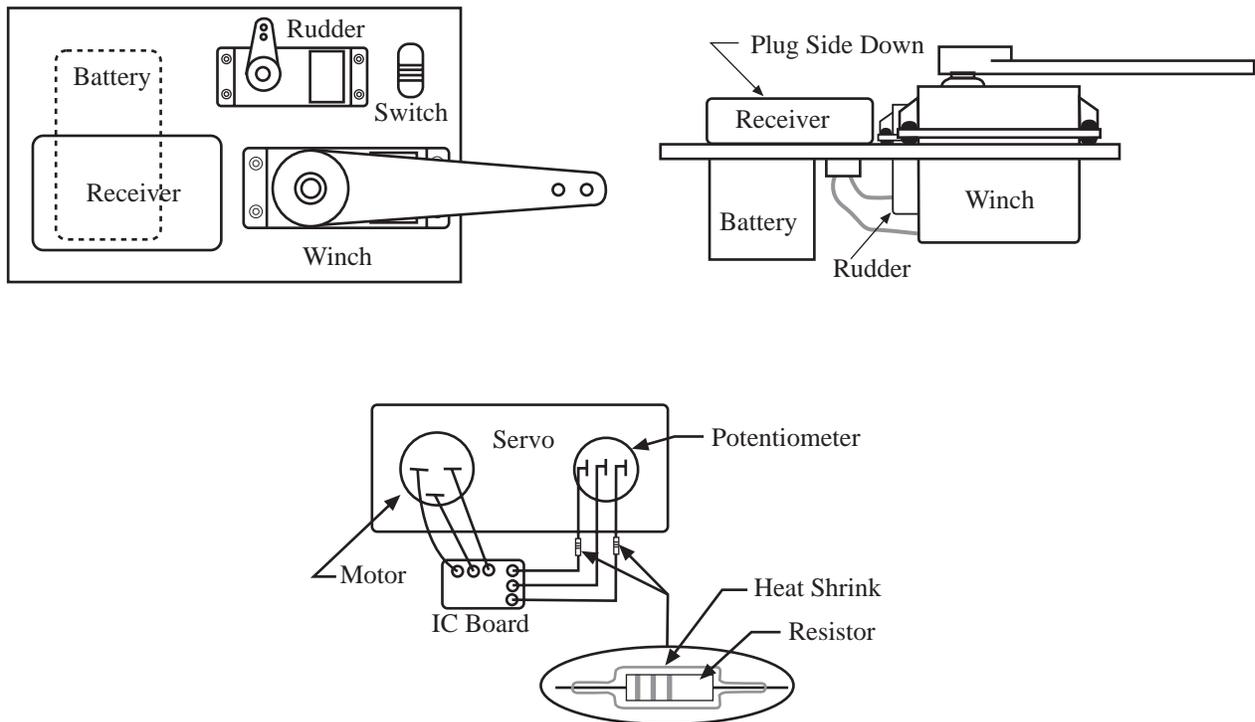
PROPORTIONAL WINCH LAYOUT

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.

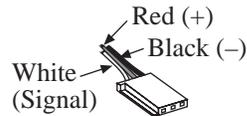


Figure 1. The Futaba "J" connector. The tab can be cut off so a Futaba connector will fit other systems.

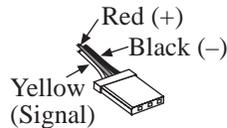


Figure 2. The Hitec connector. Except for the color of the wires this connector is identical to the one used by JR.

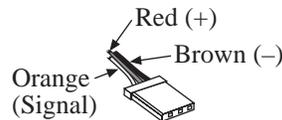


Figure 3. The JR Radio connector. For all practical purposes it is identical to the Hitec connector.

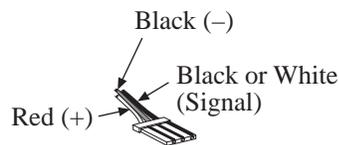


Figure 4. The Airtronics connector. Note that (+) and (-) are reversed from Futaba, Hitec, and JR connectors.

CONVERTING A 90° WINCH TO 180° OPERATION

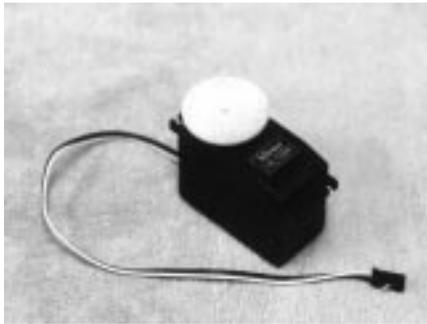


Figure 1. The Hitec RCD 715 BB.

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

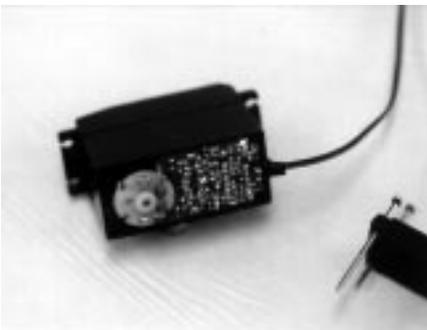


Figure 2. In this photo the motor is to the left and the integrated circuit board is to the right of the case.

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

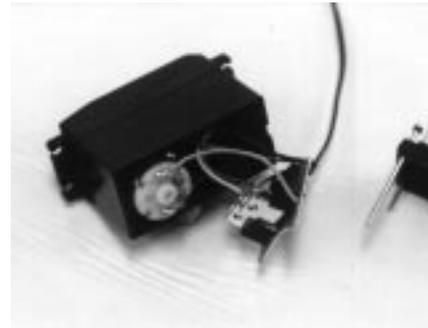
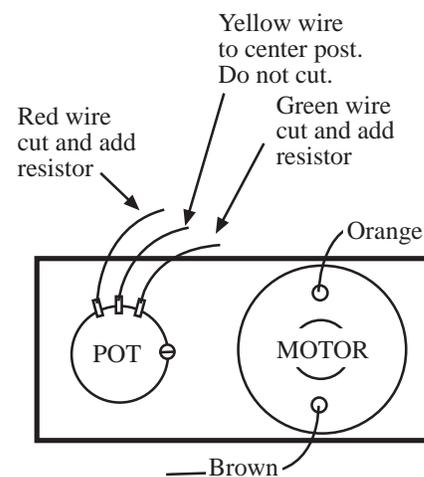


Figure 3. Using a small screwdriver, gently pry the integrated circuit board out of the case.

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).



Brown and orange wires from motor to printed circuit board.
DO NOT CUT.

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.

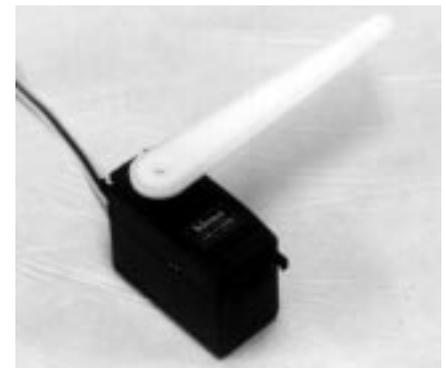
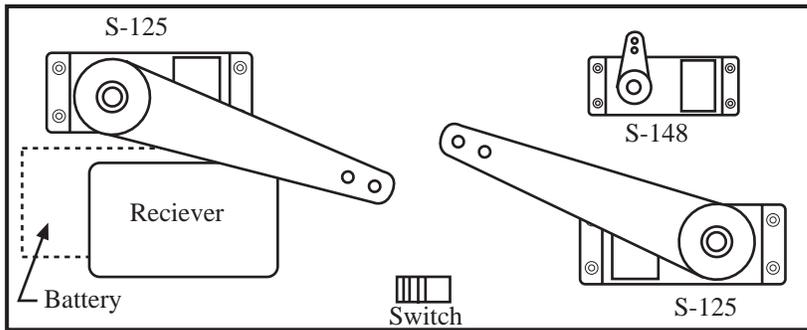


Figure 6. Insulate the new connections before stuffing everything back into the servo case. I use electrical tape.

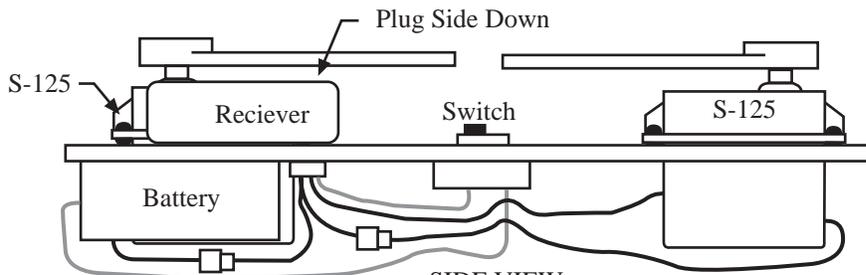
RADIOBOARD WITH 2 S-125'S AND 2 CHANNEL RECEIVER

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

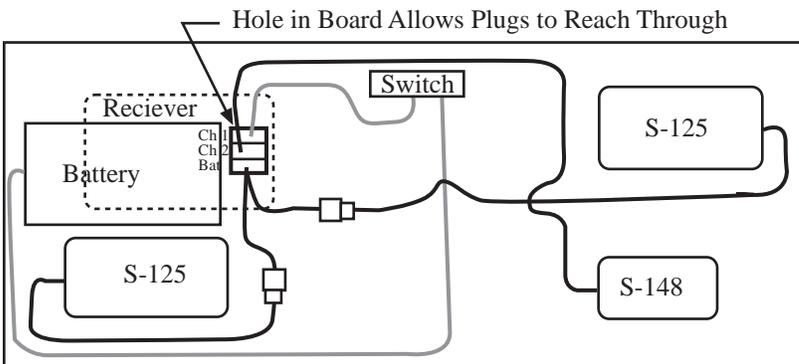
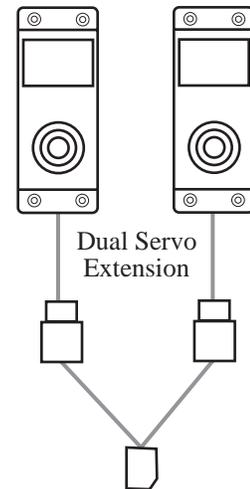
plugged into the receiver channel controlled by the left transmitter stick. You do not have independent sail trim with this arrangement. The S-148 servo is used for rudder control.



TOP VIEW



SIDE VIEW



BOTTOM VIEW

CONVERTING A FUTABA S148 TO A DRUM WINCH

By Scott Vernon,

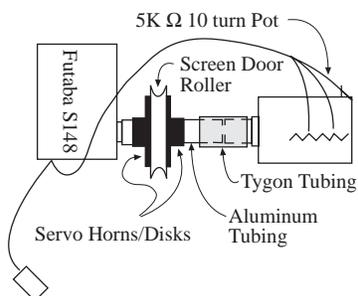
With thanks to Charles Baltzer.

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.

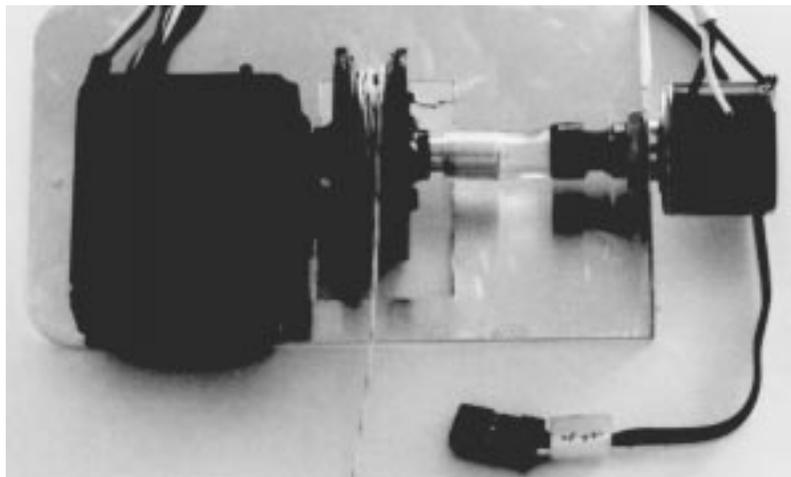
Make a drum. The easiest drum is made from a sliding screen door nylon roller sandwiched between two servo horns/disks. Bolt/screw them together. When you drill across the roller make sure you do not penetrate where the line will wrap. Other larger drums may be more desirable. Use your imagination - 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.

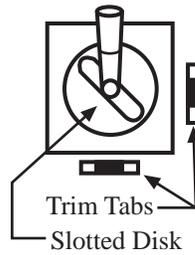
I like to run the sheets out of the boat at the transom. This allows me to have the elastic on deck - it is necessary to keep the line wrapped around the drum taut with elastic as with any sailwinch and it is good to release the tension when the boat is not being used.



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

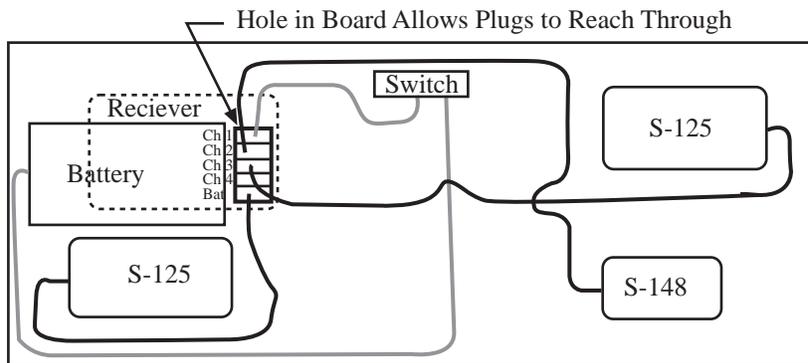
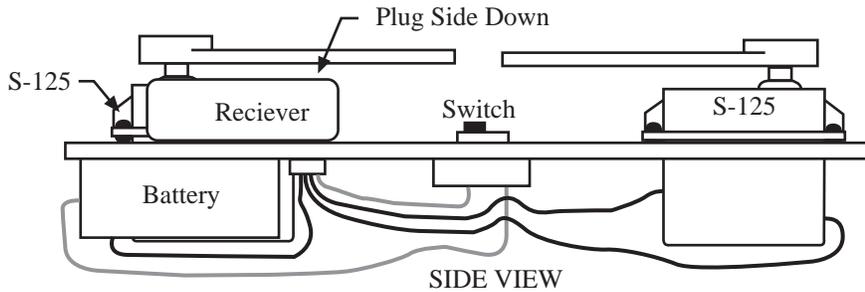
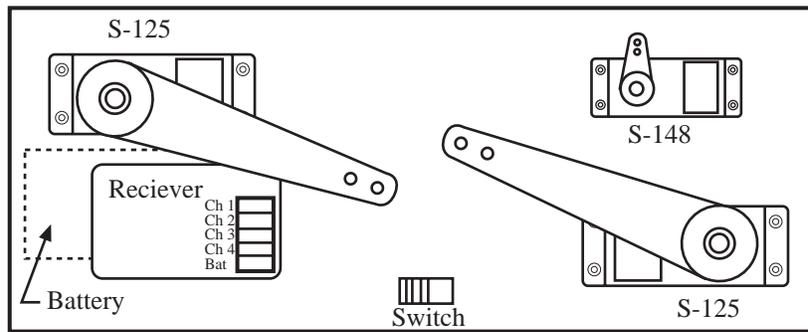
This arrangement gives proportional sail control, with two S-125 arm type sail winches and four channel receiver. And independent sail trim.

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.



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.

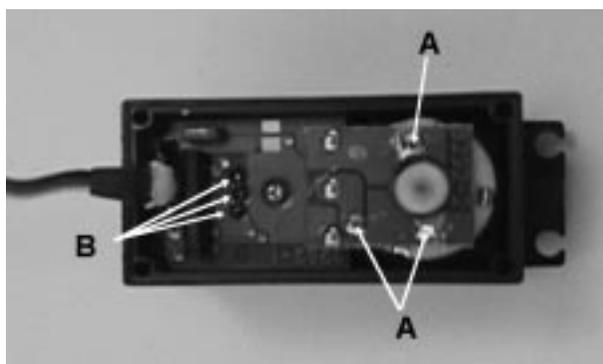


Figure 2. Open the servo case being careful not to damage the O-ring seal. You'll see two printed circuit boards connected by three (3) jumper wires. Remove the screw holding the PC board labeled S202-1 and desolder the three connections to the motor on the board labeled S202-2, marked A.

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.

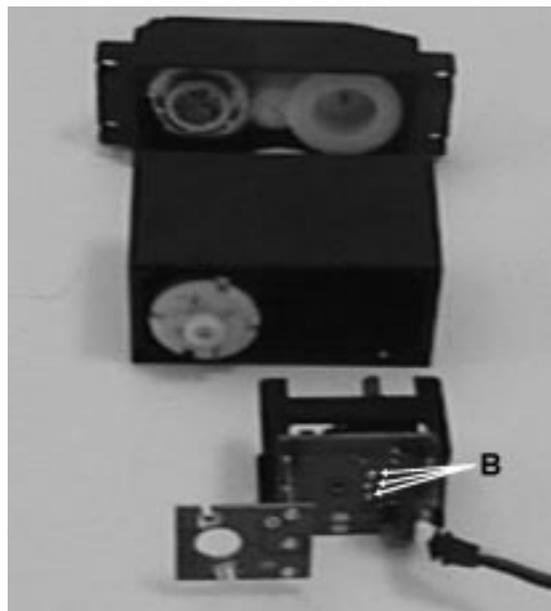


Figure 3. Remove the top of the servo case, keeping the gears in order in the top cover. Remove the small white plastic key under the output gear and gently push down on the brass shaft of the feedback potentiometer to remove both printed circuit boards, see figure 3. Now desolder the three leads (B)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

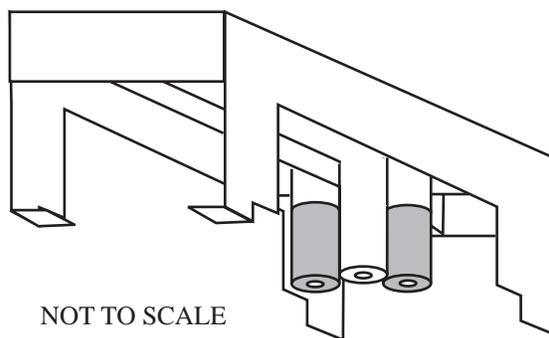


Figure 4. Modify the plastic holder by cutting away the shaded part of the outside two tubes.

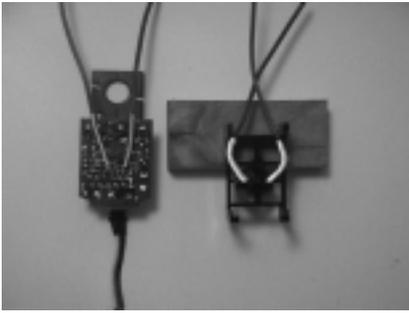


Figure 5. Slide the feedback pot back into the holder and bend the outside leads over as shown. Cut four pieces of thin wire and solder two to the bent over leads. Insulate the connections with heat shrink tubing. Solder the other two wires in the outside holes in the pc board vacated by the bent over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

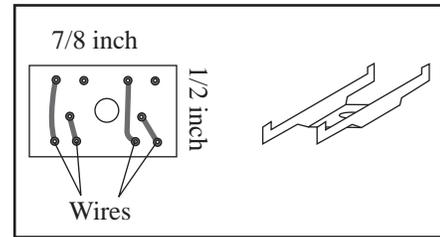


Figure 7. Layout for the new circuitboard and plastic holder to hold the trimmer pots. The author notes that a simple piece of thin plywood or plastic will also work.

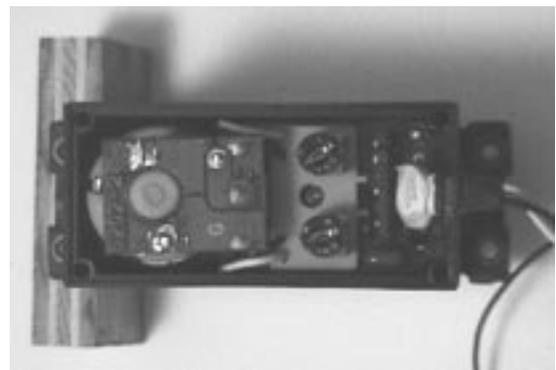


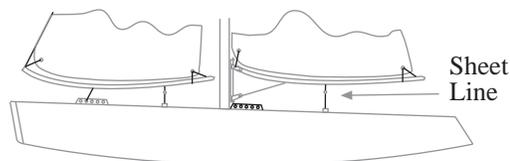
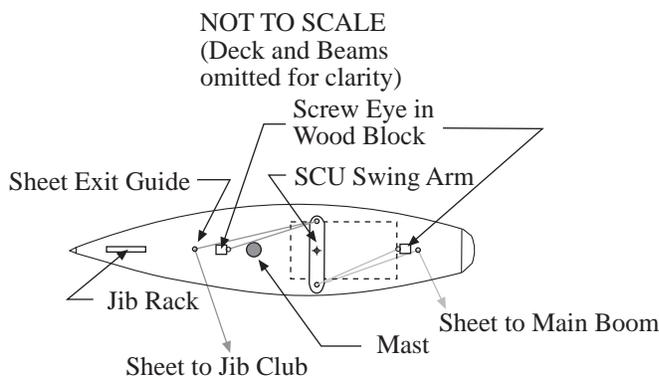
Figure 8. This is what it should look like before reinstalling the bottom cover.

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.

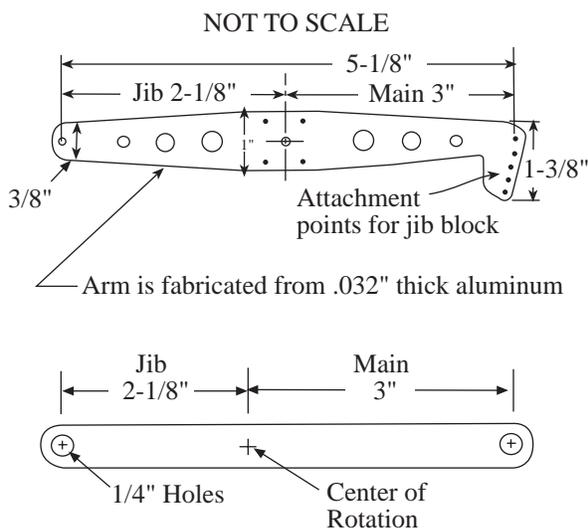
ARM WINCH SETUP SCU AND SHEETING

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.

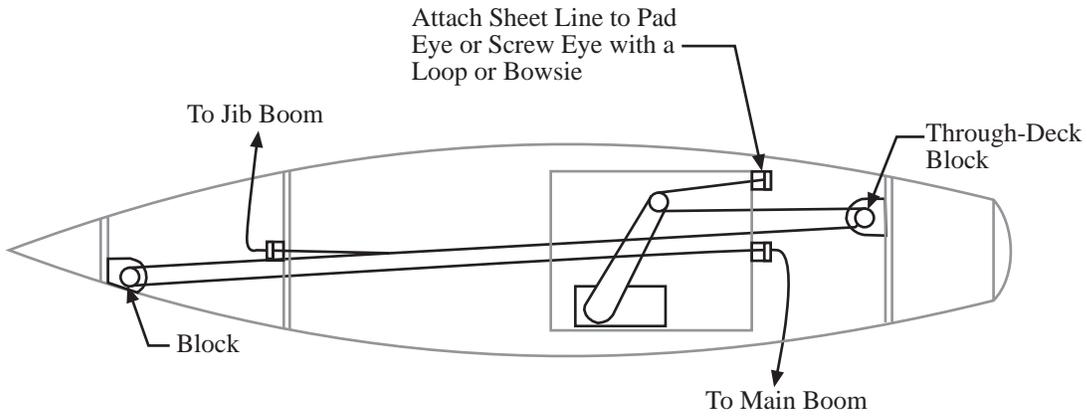
Determining Winch Arm Length

(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.

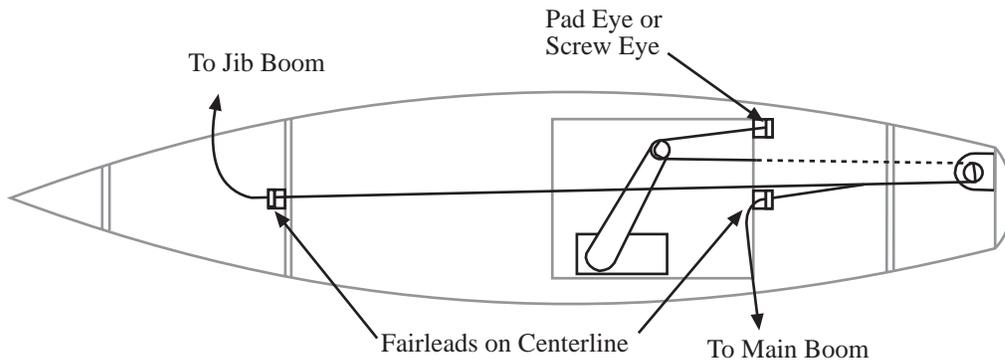
SINGLE ARM WINCH SHEETING

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

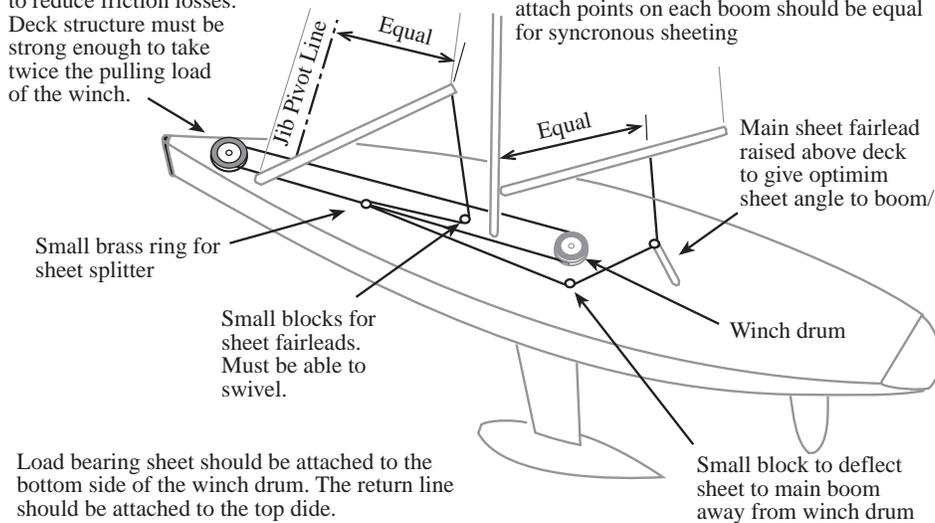
This is another arrangement for single arm sheeting, which can be used in wide hulls with easy access in the stern. It also has most of the sheeting above deck.



DRUM WINCH SHEETING

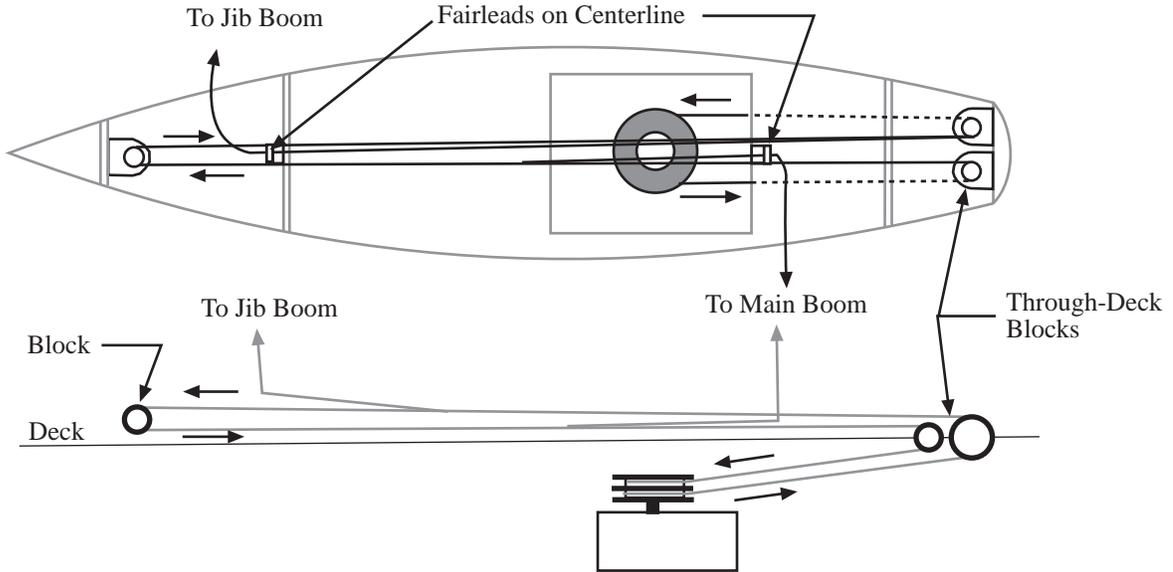
Use large diameter bow return pulley to reduce friction losses. Deck structure must be strong enough to take twice the pulling load of the winch.

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

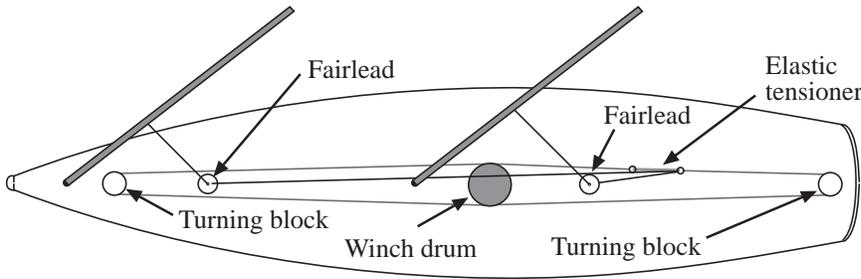


DRUM WINCH SETUP

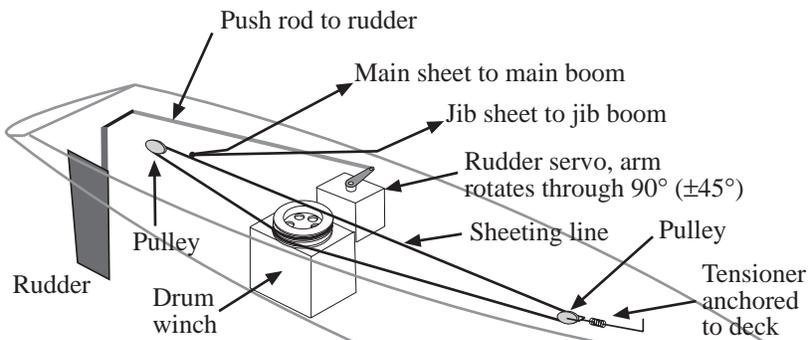
This arrangement for a Drum Winch has “Continuous Loop” sheeting, for narrow hulls with limited access. Most of the sheeting is above deck



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



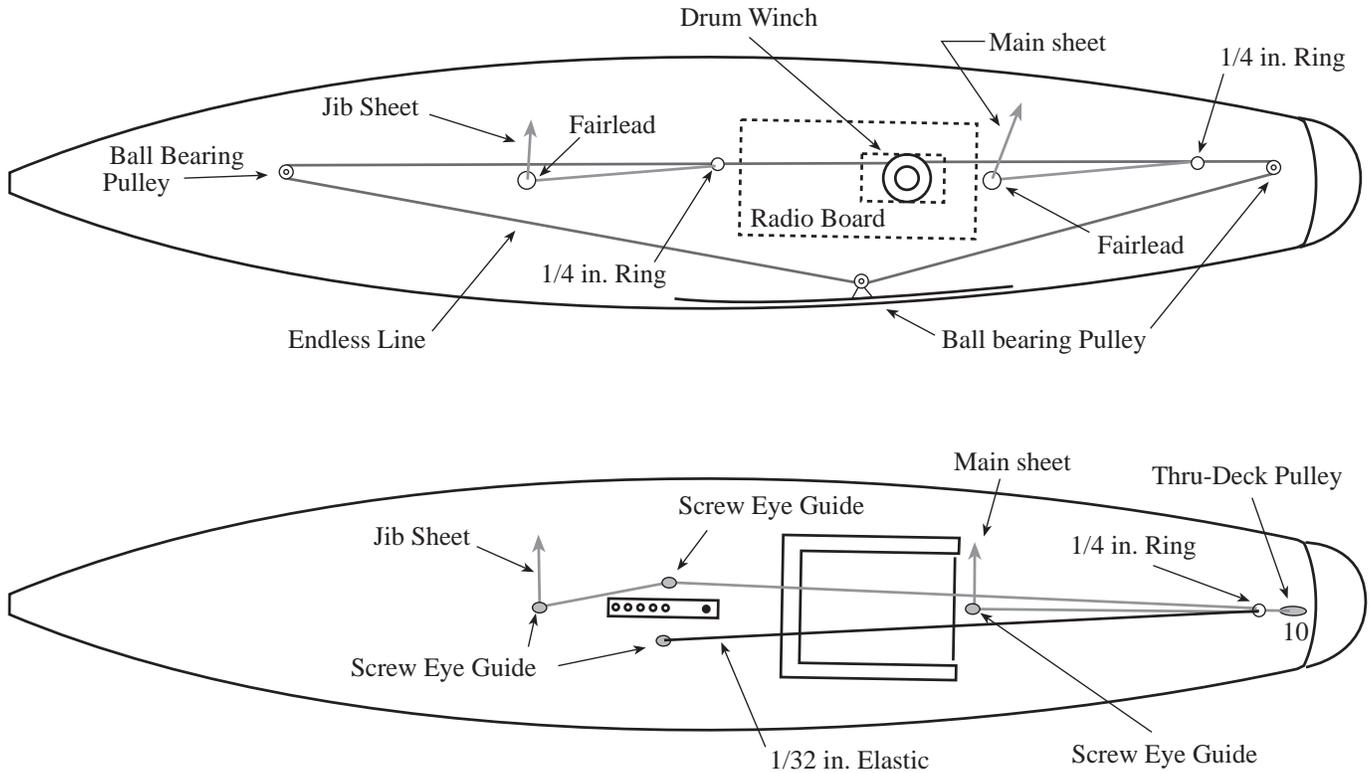
This is the sheeting arrangement used by Jim Linville for his latest US One Meter. The drum winch (a Futaba 5801) drives a loop of 80# Spectra that is lead through turning blocks at the far ends of the hull and held in tension by an elastic stretched between two rings. Sheets are fed to the booms through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



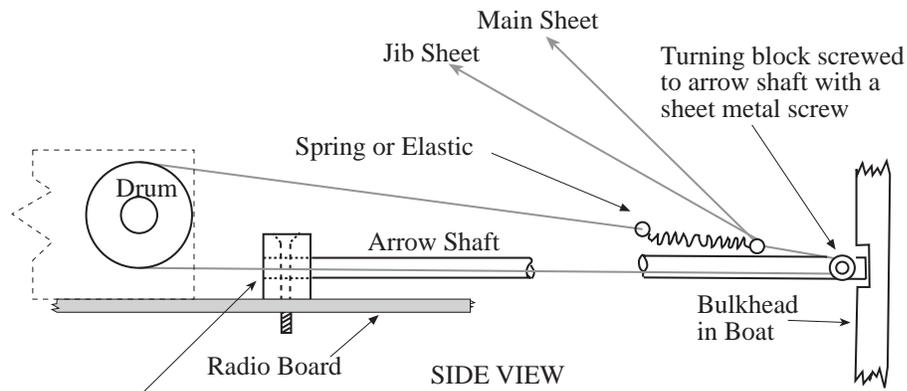
Two channel radio required.
One channel controls rudder through servo.
Second channel controls main and jib booms simultaneously through drum winch.

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

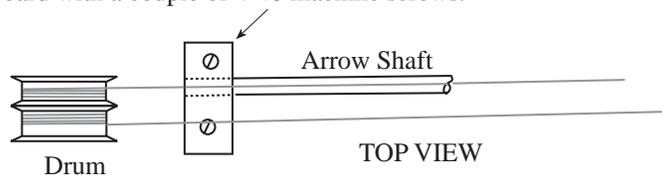
Typical method of controlling the rudder and sails of an R/C racing yacht with a two-channel radio.



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-

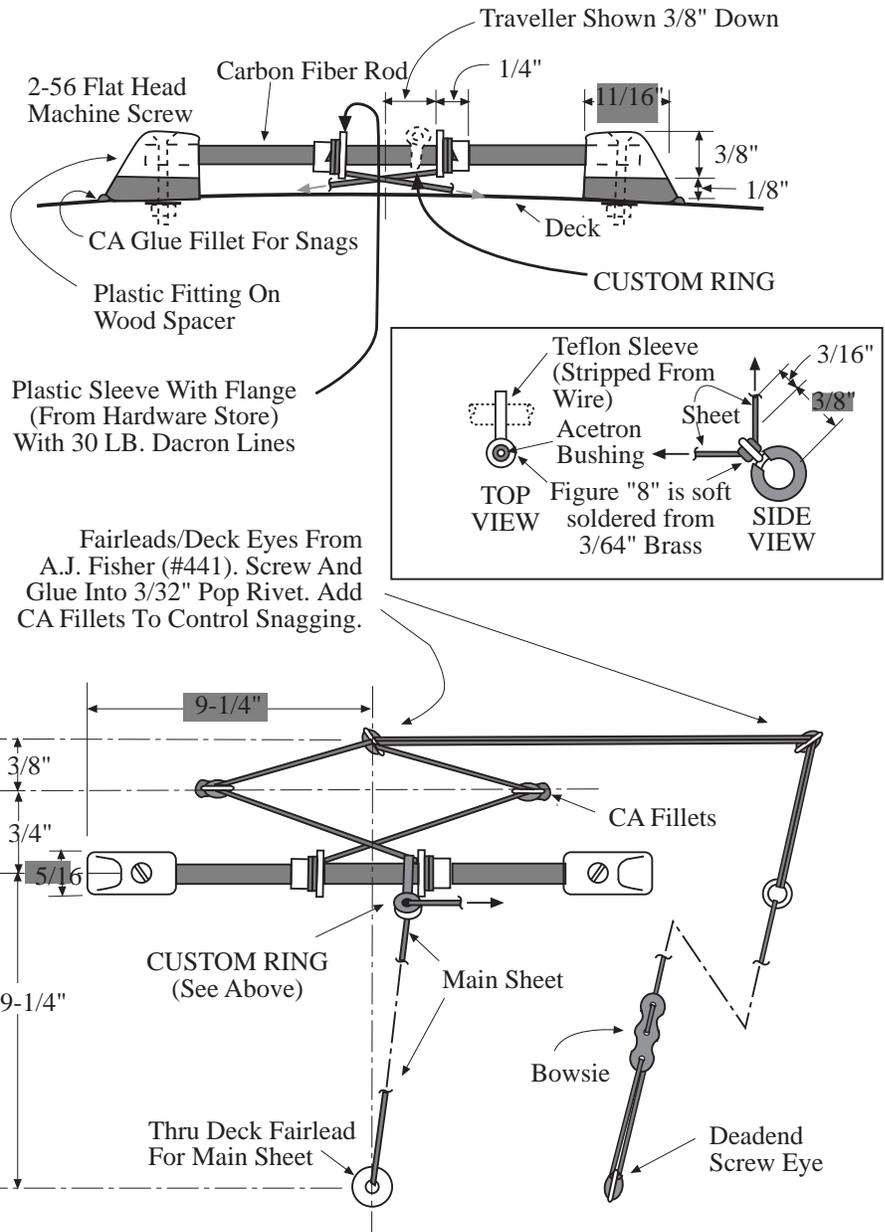


Figure 1. Main sheet traveler used by Bob Wells on his EC-12. The author believes that in winds under six to eight mph, a traveller does not make your boat go faster. However, when the wind is in the six to eight mph range or greater, a traveller increases boat speed enough to make the hassle of using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

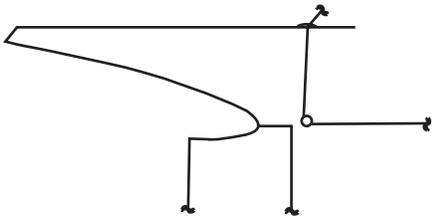


Figure 2. The mainsheet is lead to a block in the bilge of the boat, and then passed up through a small transverse slit in the deck lined with Tivar plastic.

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 through 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

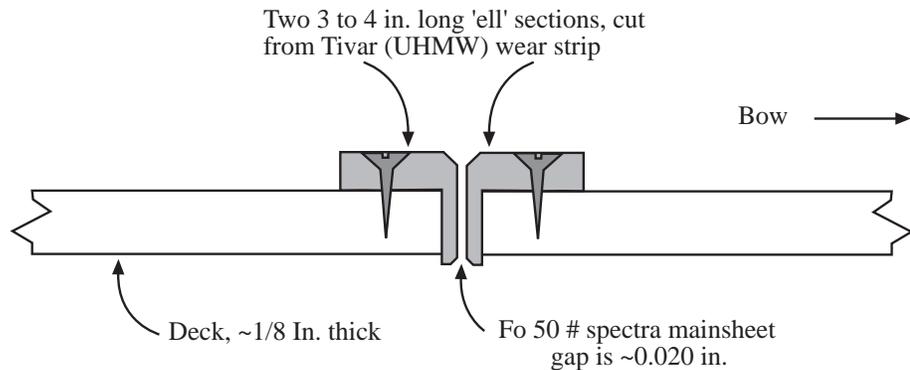


Figure 3. The mainsheet passes through a small bell-mouthed grommet (custom turned from Acetron).

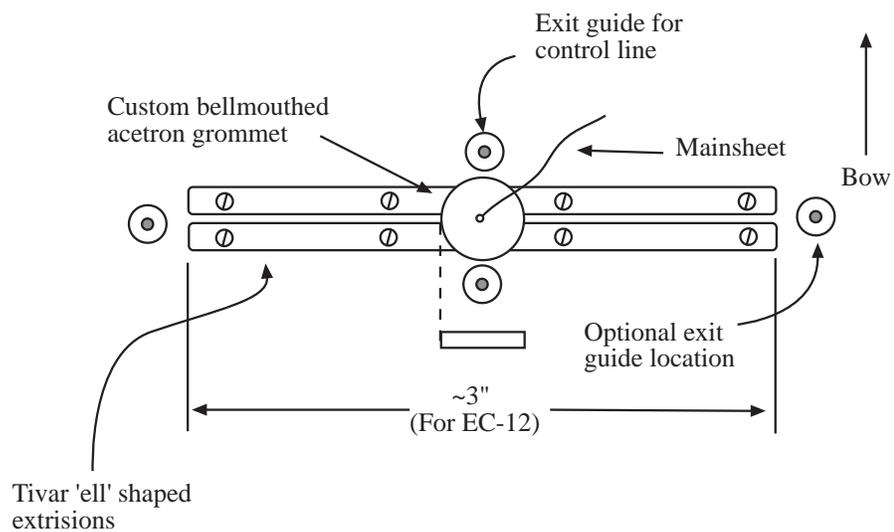


Figure 4. The control lines, tied to the grommet, go through the exit guides, then off to a block (not shown) on the inwale.

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.

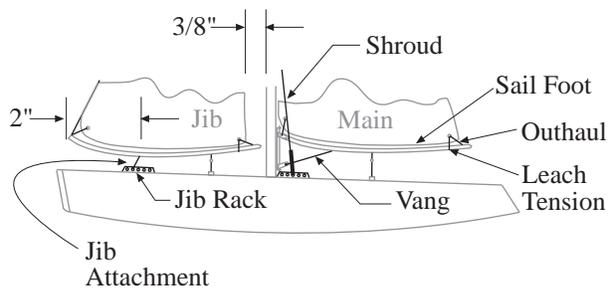
TUNING

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

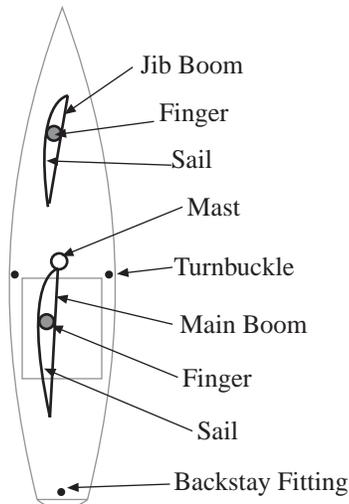


attachment back to about 2 1/2 inches. If wind is light use 1 3/4 inches. Move the attachment at boom and Jib deck rack to maintain 3/8" spacing (slot) between Jib and Mast.

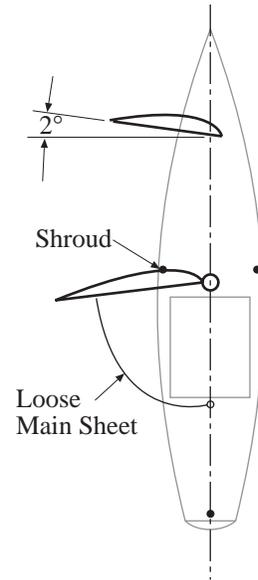
Line up end of Jib boom half way between Mast and Turnbuckle

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.

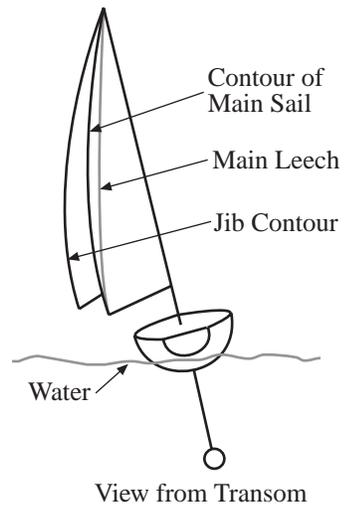


With sails let out set Jib boom approximately 2 deg. beyond right angle. Allow some slack in Main sheet. When sails are pulled in slightly the Jib will be at right



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.