MUTINEER AND BUCCANEER RUDDERHEAD INSTRUCTIONS

By Bob DeRoeck Rev 0. March 4, 2005

Intro

These instructions are for building a new rudderhead, tiller and tiller extension for either a Buccaneer or Mutineer. Before you start this project I'm going to give you some idea of the cost and man-hours required. Then you can decide if you want to proceed or just buy a rudderhead from Ida Sailor, Nichols, or Harry. See photos of the entire rudderhead assembly including the tiller and tiller extension on the Yahoo Buccpix2 egroup site. Look in the Photos section under "DeRoeck".

The reason I built my own rudderhead was primarily because I thought all the commercially-available ones were under-engineered and were likely to fail, and of course that would happen at the worst possible time. I saved some money by making my own rudderhead, but cost savings was not an incentive for me. It took me about 10-12 hours to make the rudderhead, tiller, and tiller extension. But, about 3 hours of that was design time. These instructions including the imbedded drawings, which, along with the separate PDF files with the CAD drawing for each aluminum side plate and the assembly drawing, will give you a complete design. So, figure about 10 man-hours of your time and you should be in the right ballpark.

I wanted this rudderhead, tiller, and tiller extension to be bullet-proof, so I spent extra money for the best quality materials (except those I got for free from my town dump, but even those where pretty good quality. I'm always amazed by what people throw away.). The best pintles and gudgeons will cost you about $62 plus shipping, but they should outlast you. I used 1/4" thick aluminum plate (type 6061) for the side cheeks since I thought the 3/16" thick stuff was insufficient. I paid about $25 for this aluminum. Gordon Brookfield also built a rudder to this design. He got his aluminum for the side plates for $16 but had quotes as high as $90. I suggest you look around your home for commercial metal dealers that may sell cut-offs relatively cheap. Figure about $15 for SS fasteners. You can make the tiller out of scrap wood. I used scrap fir flooring from the dump. The tiller extension I made from scrap aluminum tubing from the dump. Finding scrap tubing is relatively easy, however a good quality tiller pivot will cost about $28 plus shipping, but it should last a lifetime. You'll need scrap formica, scrap oak, and scrap ultra-high molecular weight polyethylene (UHMWPE). The biggest supply problem may be the "C"-section or "channel iron" for the back end of the tiller, which fits over the rudderhead, attached with a pivot bolt. This allows you to raise the tiller upward while sailing. I and Gordon used a piece of SS channel iron which started out as a box or square section 1.75" on each side that I picked up at the dump. Unfortunately, I have no more of this to give away. So, you will have to find a piece of SS or heavy-duty aluminum 8.75" long, with a distance between the two sides of the "C" between 1.75" and 2.0", and with a height of each side of the "C" of 1.5-1.75". Again, I suggest looking locally for a commercial metal dealer that sells cutoffs. I suggest 16 gauge 304 SS for

this "C" section or 12 gauge aluminum of either the 5000 or 6000 series. Note, you can also get this as a box or square section and cut it into a "C" section with a hacksaw (use a bimetallic blade for cutting SS).

So for costs figure $65 for pintles and gudgeons, $40 for aluminum if you can't get it cheaper locally, $20 for a "C" section, $15 for fasteners, $30 for a tiller extension swivel, and $15 for a small camcleat for the holdup/holddown line for the rudderblade. Total cost of materials looks to be about $185, but you may be able to reduce this by up to $30 if you can get the aluminum plate and "C" section pieces cheaper.

You will also need access to basic work-working tools including a drill, tablesaw, hand electric jigsaw, rasp, sandpaper, etc. For metal working you will need bi-metallic metal jig-saw blades, hand hack saw with bi-metallic blades, a decent file and cobalt drill bits if your "C" section is SS. If aluminum, regular highspeed steel drill bits are OK.

OK, that should give you an idea of the cost and effort involved. If you want to proceed, I suggest you start looking locally for the aluminum plate and the "C" section in SS or aluminum.

Fair Winds and a Robust Rudder System,

Bob DeRoeck

General. I made my rudderhead with the side cheeks made out of ¼" thick aluminum plate (type T6061 T6). This grade of aluminum has reasonably good corrosion resistance in salt water. Use a grade of aluminum in the 5000 and 6000 series for reasonable corrosion resistance.

Would 3/16" thick plates be adequate? I asked myself that question while I was designing the rudderhead. Harry Sindle's rudderheads and NBW's rudderheads have 3/16" thick aluminum plate with a number of relatively large holes (approx 1.75" diameter) drilled in each plate to reduce weight. I checked a number of these rudderheads on both Mutts and Bucs and found that in most cases the aluminum had bent outwards on each side plate between the rudderblade pivot bolt and the bottom of each side plate due to sideways force exerted on this area by the rudderblade. This results in the rudderblade not being perpendicular with the bottom plane of the hull. I decided to use ¼" thick side plates with no weight reduction holes to reduce the possibility of the side plates bending and to give me a greater confidence factor that the rudderhead would not fail in extreme sailing conditions. Note, I was 2 miles offshore on Massachusetts Bay in my Mutt when my original Chrysler rudderhead failed. Fortunately, I had my 2 HP Honda outboard with me or I could have had a real problem. I would rather carry 1-2 pounds of additional weight in my rudderhead then have a similar failure in the future. And, from a racing standpoint, if your rudder system fails, that is usually the end of your regatta.

In keeping with the concept of designing a rudderhead with maximum reliability, I utilized what I consider to be one of the best pintle/gudgeon systems available. The pintles and gudgeons cost about $65, not cheap, but I'm confident they will last my lifetime with little chance of failure. The details are given in the materials list shown below.

I used soft wood for the tiller to minimize weight and cost, while achieving excellent strength. For my Mutt I used some scrap ¾" thick fir flooring, gluing two pieces together to get a tiller 1.5" high. This wood is clear (no knots and checks), lightweight and very strong. There are plenty of options for tiller wood. Many people use hardwood and they may look pretty, but I prefer to put extra weight in a rudder system into strength in the rudderhead rather than good looks.

There are two sets of drawings at the end of this file. The first shows the assembly detail for the pintle straps. The second shows the details of the tiller design. There are also two separate PDF files that need to be accessed from the files section of this egroup list. The first is the CAD drawing of the aluminum side plates. The second is a CAD drawing which shows the assembly details.

Fittings. All fittings are stainless steel, wood, or plastic to minimize corrosion. The only portions of the entire rudder system that are not are the aluminum side plates. All the fasteners are SS. Many of the fittings I made from Ultra-High-Molecular-Weight-Polyethylene (UHMWPE), which is the stuff white plastic cutting boards are made of. UHMWPE is easy to work with basic woodworking tools, is strong, relatively light and holds up to the suns ultra-violet rays pretty well. I used a retired cutting board as my UHMWPE stock. UHMWPE can be purchased as stock from hobby shops and supply houses, but it's probably cheaper to just buy a cutting board if you can't find a grimy one in your kitchen to "retire" from cutting service.

Cutting Aluminum Side Plates. Apply the pattern to the ¼" thick aluminum plate for each side plate. Both side plates are identical except for the countersinking of the lower pintle fasteners. Use a jig saw to cut out each side plate. The challenge in cutting aluminum is that it has a very low melting point. If you run the saw at too high a speed it will melt aluminum which will fill in the gaps in the teeth of the saw blade, making the blade useless. So, if you have a variable speed jigsaw, set it for low speed. Also put cutting or lubricating oil on the cut line to provide a bit of lubrication and cooling. Don't try to cut too much at one time. I found that by using a low speed and cutting about ½" at a time, before taking a 2-3 minute break that the aluminum would not melt. If you only have a fixed, high-speed jigsaw, use lots of oil or water as cooling fluid, make short cuts and take lots of breaks.

After the side plates have been cut out use a file to smooth the corners and slightly round-off the sharp edges all around. Use 80 grit sandpaper for final rounding off of the edges.

Next, drill the holes in both side plate for the upper pintle machine screws, the lower pintle machine screws, the rudderblade pivot bolt, the tiller pivot bolt, the pulley ¼" bolt

and the #10 MS located within an inch of the pulley ¼" bolt. Clamp the two sideplates together so that they line up perfectly. Then drill each hole through both plates at the same time. If you have access to a drill press, use it to ensure the holes are drilled perpendicular to the plates. If you are using a hand electric drill, get two helpers to guide you as you drill, one in front and one on the side, to make sure that you are holding the drill perpendicular to the side plates as you drill your holes. If these holes are not drilled perpendicular to the side plates the rudder will not be symmetrical. **This is very important! Take your time and do it right.** You can use regular highspeed drill bits for drilling the aluminum. Also, before drilling any metal, always use a sharp-pointed punch to make an indentation in the metal. This will allow the bit to start cutting in the proper place without "walking" around.

Note, use a moderately larger drill bit for the #10 MS which hold the pintle straps to the side plates. This will allow you to reposition the pintle straps a bit when assembling the rudderhead. It is important that the pintles line up or they won't fit into the gudgeons properly which will cause the pintles to bind in the gudgeons. By having the holes somewhat larger you will be able to adjust the pintles slightly during assembly to line them up properly. In theory this is not necessary. But, in reality, you will not get the pintle holes drilled exactly in the right spots in the side plates and the larger holes will allow adjustment.

Spacers. There are two types of spacers used to hold the side plates the correct distance apart. At the top there is a large spacer located between the tiller pivot bolt and the front cut out notch. This piece is about 3.5" long and 1.5" wide. The thickness is 13/16". I made this "block" spacer out of red oak. Any hardwood should work fine. I would not recommend using softwood. UHMWPE would also work fine, but it would mean having to find a piece that is 13/16" thick or thicker. It'll be easier to find a scrap piece of hardwood this thickness. In either case use a tablesaw to cut the block spacer to the correct dimensions.

The other spacers are PVC "pipe" spacers. I used ½" pvc pipe cut to 13/16" long. I recommend using a chop miter saw for cutting this pipe to ensure the cuts are 90 degrees. If you have a good quality hand miter box, that would work as well, but chop miter saws are more readily available nowadays. To make assembly easier, after I cut the pipe spacers, I squirted some Great Stuff expanding, insulating foam into each one. After the foam set, I drilled holes for the #10 MS in the center of the foam. This prevents the pipe spacers from moving around about the MS while you're trying to tighten the MS's. You will need 3 pipe spacers, but you might as well make a few spares while you're doing it.

Shims. Two types of shims are required. The first type is for the pintle straps. These go between the outside of the side plates and the inside of the pintle straps. I used scrap formica for these shims. They need to be either 2 or 3 thicknesses of Formica to get the right thickness, depending on how thick your Formica is. You could also use UHMWPE for making these shims, but you will need a pretty good quality tablesaw to make these tall, thin cuts such that they are uniform thickness, which is essential. I glued the

multiple layers of formica together with contact cement to make assembly and possible future disassembly/reassembly easier.

The second type of shim goes on the outside of the side plates, but on the inside of the channel iron which is the end of the tiller assembly. Let's call these the tiller pivot shims. Aside from the thickness, these shims will be the same shape and size as the block spacer. The thickness of the shims will depend on the dimensions of the channel iron you use. The fit should be relatively tight between the inside of the channel iron and the outside of the shims once they are attached to the rudderhead assembly. If not, the tiller will wobble about on the top of the rudderhead. You could use hardwood or UHMWPE for these shims. I would not recommend using softwood.

Rudderblade Uphaul Pulley System. A sheeve is installed at the back of the rudderhead for the uphaul line on the rudderblade. I used a 1 & 1/8" diameter, 3/8" thick acetal sheeve. Putting a 3/8" wide sheeve in a 13/16" gap will cause the line to jump off the sheeve, so the line needs to be retained. This is accomplished by making another sheeve to put on the same ¼" bolt as the acetal sheeve. This "blank" sheeve is 1.5" in diameter and 3/8" thick. It can be made from hardwood or UHMWPE. I used a 1.5" hole saw to cut out the blank plus the ¼" center hole at the same time. However, it could be roughed out by hand just as well, since it is only serving as a spacer/retainer. It doesn't have to be perfectly round. This larger sheeve practically touches the pipe spacer located about 1" away from the pulley bolt to the rear and below. This effectively constrains the uphaul line on the smaller sheeve.

Rudderhead Assembly. OK, you're ready to start assembling the rudderhead. First, use a countersink to countersink the holes for the lower pintle strap #10 flat head MS's. A regular high-speed steel countersink will work just fine cutting the aluminum. Don't make these countersinks any deeper than necessary. You want the top of the flat head MS to be just below the surface of the side plate. See the drawing at the end of this file for details.

Next, install the rudderblade pivot bolt using a spare pipe spacer located near to the pivot bolt. This is only temporary and is useful because the pivot bolt will service to correctly lineup both side plates during rudderhead assembly.

Next, make up a sandwich of the two side plate, the block spacer, and the two tiller pivot shims. Make sure all of the shims and the spacer are in the exact position, then clamp them tightly using a vice or C clamps. Then drill holes for 4 wood screws that will hold each side plate and tiller pivot shim to the block spacer. Approximate locations for the holes are shown on the CAD drawing of the side plate. Note, the holes on either side of the rudderhead cannot line up with those on the other side. They must be staggered or else the screws on either side will interfere with the others. You will have to drill these holes in two steps. A large diameter bit is required to drill through the tiller pivot shim and the aluminum sink plate only. This portion of the hole will contain the thick, unthreaded portion of the wood screw. A much smaller diameter bit is required to drill into the block shim, one that is sized for the threaded portion of the wood screw.

Countersink the holes in the tiller pivot shims so that the flat head wood screws will be flush with the shim surface.

Next, attach the pulley bolt with the two sheeves to the rudderhead. Then install the pipe spacer located close to the pulley bolt using a #10 MS. Tighten this MS tight and have the pulley bolt with nylock nut slightly loose so that the pulley is free to rotate.

Next, install the upper pintle using pipe spacers and the formica shims. Install an eyestrap on the starboard side of the pintle strap for a rudder retaining line. See below for more details on this eyestrap. Just tighten the nuts hand tight for now.

Next, install the lower pintle using the formica shims. The ¾" long #10 flathead MS are installed with the head on the inside. This is a bit tight and you may want to borrow someone with small hands for this step. First, put a dab of silicon sealant into the countersink hole on the sideplate. This is to reduce galvanic corrosion between the aluminum side plate and the SS MS. You'll need a right-angle Phillips head screwdriver to get the screwdriver head between the two side plates when you are tightening the lock nuts.

OK, start tightening all the fasteners now. Before final tightening of the pintle strap MS's use a long straight edge to ensure the shafts of each pintle are exactly in line with each other. I found that a hacksaw blade works well for this lining up exercise. Be sure you have used nylock nuts for all MS's and bolts. The final step in the rudderhead part of the project is to cut off the excess bolt and MS length with a hacksaw. Be sure to use a bimetallic blade. Then round off the corners of the end of the bolts with a file to reduce the risk of cutting yourself on a sharp edge in the future.

Eyestrap. The eyestrap required for the retaining line is attached to the upper pintle starboard strap. The holes in the strap are located 2" apart. I couldn't find a small eyestrap with this large hole spacing, so I fabricated one from the elements. Use some scrap SS, relatively light gauge (say 20 gauge), something you can cut with tin snips. Cut a piece ½" wide by about 3.5" long. Use a 3/8" bolt as a mold and bend the strap around it to create the eye. Use two vise grips to bend the legs 90 degrees. Finish up by drilling the two mounting holes 2" apart, cutting any excess length from each leg, by rounding all corners with a file and sanding sharp edges smooth. While this strap may distort if there's a big load put on it, it will not fail and your rudder will stay with the boat after a capsize.

The rudderhead is done. Now, let's move on to the tiller.

Tiller. See the tiller drawings at the end of this file. The only difference between a Buc and a Mutt rudder system is the length of the tiller and the tiller extension. The dimensions for the tillers that I recommend for each boat are shown on the drawing. The length of the tiller can be modified to suit the owner. The length dimensions I have shown are based on the skipper being on the rail, hiking out and with his aftmost side located at the back of the CB trunk. If you have unusually long or short arms you may

want to make some adjustment to the length. Set up your old rudder system on your boat, assume the correct hiking position and use some old broom handles and duct tape to determine the right length for both the tiller and tiller extension for you.

The height and width of the tiller at the rear where it connects with the channel iron will depend on the inside dimensions of the channel iron. The rear end of the wood tiller should be a snug fit inside the channel iron. The rear end of the tiller sees the greatest force and is the part most likely to break. I suggest not using any channel iron with an inside width significantly less than 1.75". For the same reason I suggest not using a tiller that's significantly less than 1.5" high. Another reason for a relatively wide tiller is to provide space for the cam cleat for the rudderblade uphaul and holddown lines.

I found that a 1 & 3/8" diameter round section at the forward end of the tiller is a comfortable fit for my hand. You may want to adjust this size upward or downward depending on your hand size.

I only completely rounded over the last 7" of the tiller. Keep the portion of the tiller underneath the tiller extension pivot fitting with a flat top so the pivot fitting will have a firm base.

For my Mutt tiller I used two pieces of ¾" thick fir flooring glued together with epoxy glue to get a height of 1.5". For my Buc tiller I used a clear piece of some kind of softwood that was 1.5" thick. The key is to use "clear" wood with no knots or checks that will weaken it.

Channel Iron. Again, SS or aluminum will work, but if you use aluminum, get stock with a significantly higher gauge than that required if SS. Round over all cut edges so that they are smooth. This will allow the tiller to fit easily over the top of the rudderhead when you pivot the tiller up or down. Sandpaper works well for finish smoothing of all cut edges.

Guides for Rudderblade Uphaul and Holddown Lines. Two guides are required for the rudderblade uphaul and holddown lines. I made both out of UHMWPE. The first is located at the very back end of the channel iron. The second is located just behind the cam cleat. See the photos in the buccpix2 egroup to get an idea of the size and location of these guides. For both guides I used a double thickness of ½" UHMWPE. I used 3/16" double braid for the uphaul line. This is connected to an eyestrap screwed into the back edge of the rudder. I used a ¼" bit to make the holes in the guide for the uphaul line. I used ¼" solid elastomer cord for the holddown line. This stretching cord will allow the rudder to kickup, if you hit an underwater obstacle. I used a 5/16" bit to make the holes in the guide for the holddown line. Install a C-clip on top of one of the guides to hold the tiller extension in place when its not in use. For the Mutt rudderhead the C-clip is on the rear guide. For the Buc rudderhead it is on the front guide.

Tiller Extension. You have a choice of tubing diameter for the tiller extension based on the size of pivot fittings available, either ¾" or 5/8" diameter. I recommend ¾" since the

¾" fitting gives a much more solid connection to the tubing plus it's easier to attach a "T" piece at the end of the tubing to hold with a two-finger grip. I recommend that you do a test fitting on your boat using the broom handles and duct tape as described in the Tiller section, above. I've found that for me a tiller extension 32" long is best for my Mutt and one 40-42" long is good for my Buc.

There are two types of pivot fittings available from APS. One type has a through bolt attached to the bottom that serves as the pivot for the horizontal direction. The bolt goes all of the way through the tiller and ends in a nylock nut. The second type has a bottom plate that is secured to the top of the tiller with wood screws or through bolts. The horizontal pivot is riveted to this bottom plate. I have one or each type on my rudderheads. I recommend the design with the bottom plate, since the pivot bolt on the first type chews up the wood around the through bolt as it pivots and requires tightening on occasion. I believe that wood screws are plenty strong for holding the bottom plate of the second type to the tiller. If you're concerned about strength, you could always through bolt the bottom plate. I used SS MS and nylock nuts to hold the tubing to the pivot fitting.

I like a "T" piece at the end of the tiller extension so I can hold the tubing between my index and middle finger with my fingers wrapped around each leg of the "T". This gives me a solid grip on the tiller extension even though I'm holding the T piece loosely. This results in less hand fatigue during long races than holding a golf club type of grip. I made a "T" piece out of ½" thick UHMWPE, rounding over the edges with a wood rasp and sandpaper. The base of the "T" is inserted into the end of the tubing and held in place with a single #8 MS with nylok nut. Originally on my Mutt I used a piece of 3/8" wooden hardwood dowel. But, it was too weak and snapped off. The UHMWPE is much more forgiving of abuse than wood.

Gudgeon Standouts. The side plates of the rudderhead will hit the aluminum rubrail on the Chrysler boats, significantly restricting how much you can move the rudder from side to side. To eliminate this problem, install your new gudgeons on standouts made of ½" thick UHMWPE. This ½" standout will allow the rudder to move about 80 degrees on either side of the centerline before the side plate hits the rubrail.

Rudderblade Nipple. If you look at the drawings for the Mutineer on the MCA site and the Buccaneer in the class constitution and racing rules, the front edge of the rudder blade is parallel with the transom. Since both boats have a reverse slope transom, this means that the front edge of the rudderblade slopes backwards. Some of the hardcore racers believe that the front edge of the rudderblade should be vertical in the water. With my rudderhead design the blade will swing forward until the front of the blade near the top hits the back of the lower pintle. This position has the front of the rudderblade close to vertical. If you want to have the front of the rudderblade sloping backwards as shown in the design drawings, then I suggest you add a bumpout or nipple to the front of the rudderblade where it hits the back of the lower pintle. I did this on my Mutt by adding a ¾ x ¾" blob of epoxy with silica filler to the front of the rudder blade. Add extra epoxy

mix and after it sets rasp/sand it down to 1/8-3/16" thickness, whatever is necessary to get the angle you want on the front edge of the rudderblade.

Retaining Spring and Line. After spending all this time making a fine new rudder system it would be a shame to lose it to the briny deep after a capsize. I suggest installing a retaining spring and also a retaining line. Maybe this is a bit of a belt and suspenders approach, but retaining springs do fail. A brand new Nichols rudder system was lost at BNAC 2004 after a capsize because the retaining spring was not sprung out enough to catch the pintle base. The Materials List has info on the retaining spring. A 3' length of 5/32 or 3/16" line will do fine as a retaining line. Use bowline knots to attach the line to the eyestrap attached to the starboard side of the upper pintle strap and to a utility snap on the other end. It takes only a second to clip the utility snap to the starboard transom U-bolt and you will be sure that your rudder will stay with the boat if you capsize.

Rudderblade Pivot Bolt. Numerous Mutt and Buc rudders have had the ¼" SS rudderblade pivot bolt fail. I recommend using either a 5/16" or 3/8" SS bolt with flat washers on both sides and a Nylok nut. Replace the original metal bushing which is located in the pivot bolt hole of the rudder with a nylon bushing. My local hardware store sells these bushings. They are 1 inch long and ½" OD and came in two ID's, one 3/8" and one 5/16". There is just a difference in the thickness of the wall between the two sizes. One provides a perfect fit for a 3/8" bolt and the other for a 5/16" bolt. Cut the bushing to ¾" long using a hacksaw. Enlarge the bolt hole in the rudderblade to ½" and insert the bushing. Then install the rudderblade.

Finish. Install the uphaul and holddown lines and you're done. Have a few beers to celebrate, then take her out for a test ride.

Materials List and Sources.

Aluminum for Side Plates. ¼" thick aluminum plate (type T6061 T6). Minimum size for the blank for each side plate is 12 & ¾" x 9 & 7/8".

Upper Pintle. APS part number RL490S
Lower Pintle. APS part number RL490L
Gudgeons (2). APS part number RL490

Rudder retaining spring. APS part number R0767 or make your own out of scrap SS

Tiller extension pivot. APS part number R0500 or R0510

Cam cleat. APS part number H423

C-clip for holding tiller extension. APS part number RF113520

Solid elastomer for holddown line. APS part number PFSC.

Utility snap for retaining line. APS part number SEDG 136800.

Acetal sheeve. 1 & 1/8" diameter, 3/8" thick APS part number RF129.

Nylon bushing for rudderblade pivot hole. From hardware store. 1" long, ½" OD and ID to fit rudderblade pivot bolt.

Fasteners:
Rudderblade pivot bolt: 3/8" or 5/16" SS hex bolt, 2.5" long (plus 2 flat washers & nylok nut)

Tiller pivot bolt: 1/4" SS hex bolt, 2.5" long (plus 2 flat washers & nylok nut)

Pulley bolt: 1/4" SS hex bolt, 2" long (plus 2 flat washers & nylok nut)

Upper Rear Spacer: #10 pan head SS MS, 2" long (plus 2 flat washers & nylok nut)

Lower Pintle Strap: four #10 flat head SS MS, ¾" long (plus 4 flat washers and 4 nylok nuts)

Upper Pintle Strap: two #10 pan head SS MS, 2.5" long (plus 2 flat washers and 2 nylok nuts)

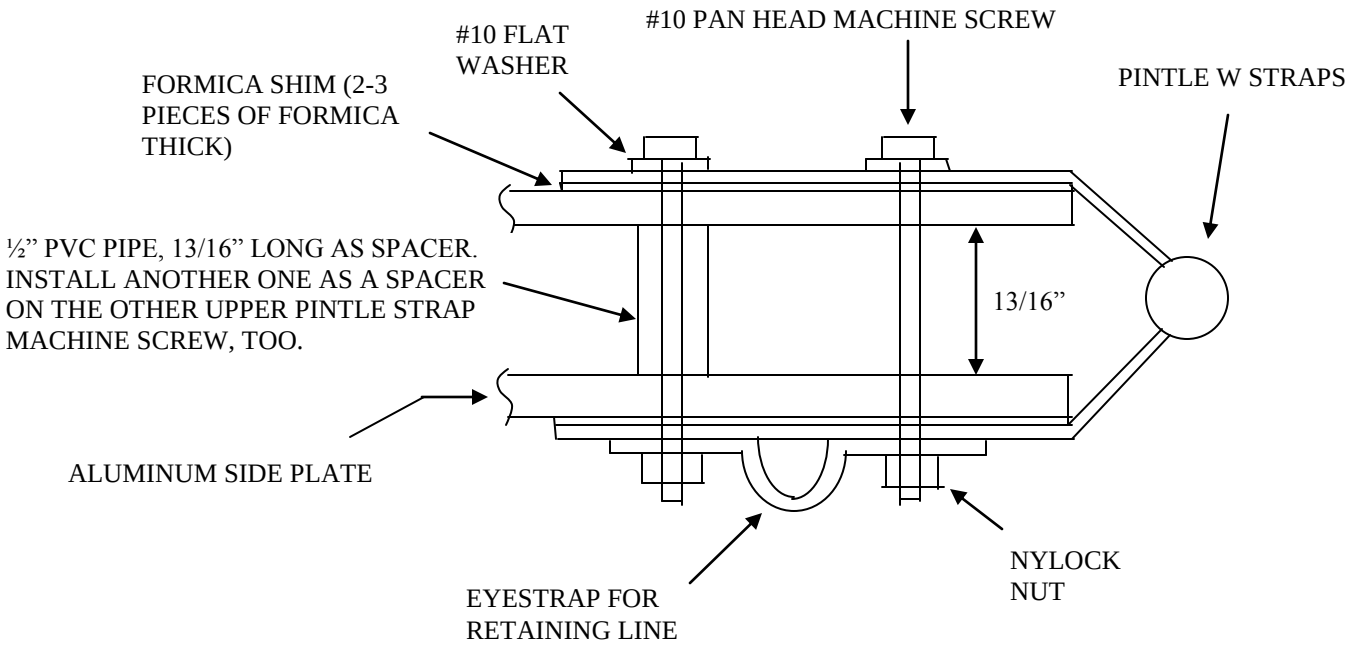
Spacing block: four #8 flat head SS wood screws, 1.25" long.

Channel Iron: three #10 pan head SS MS, 2.5" long (plus 6 flat washers and 3 nylok nuts)

Plus fasteners for each guide block, eyestrap for uphaul line at back of rudderblade, C-clip for tiller extension, cam cleat, tiller extension pivot fitting, and T-piece at end of tiller extension.

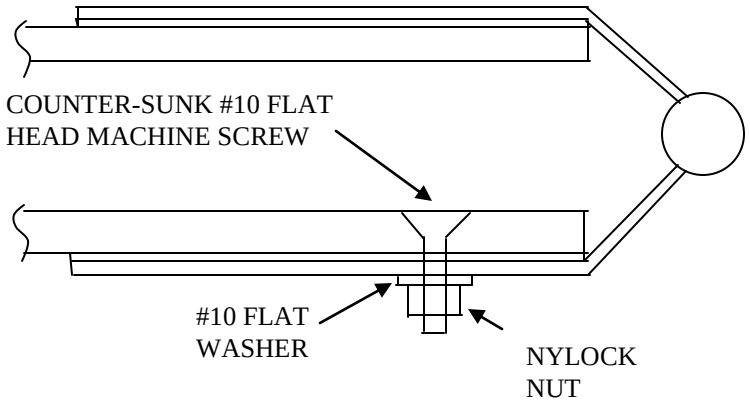
Pintle Drawings

Upper Pintle (top view)



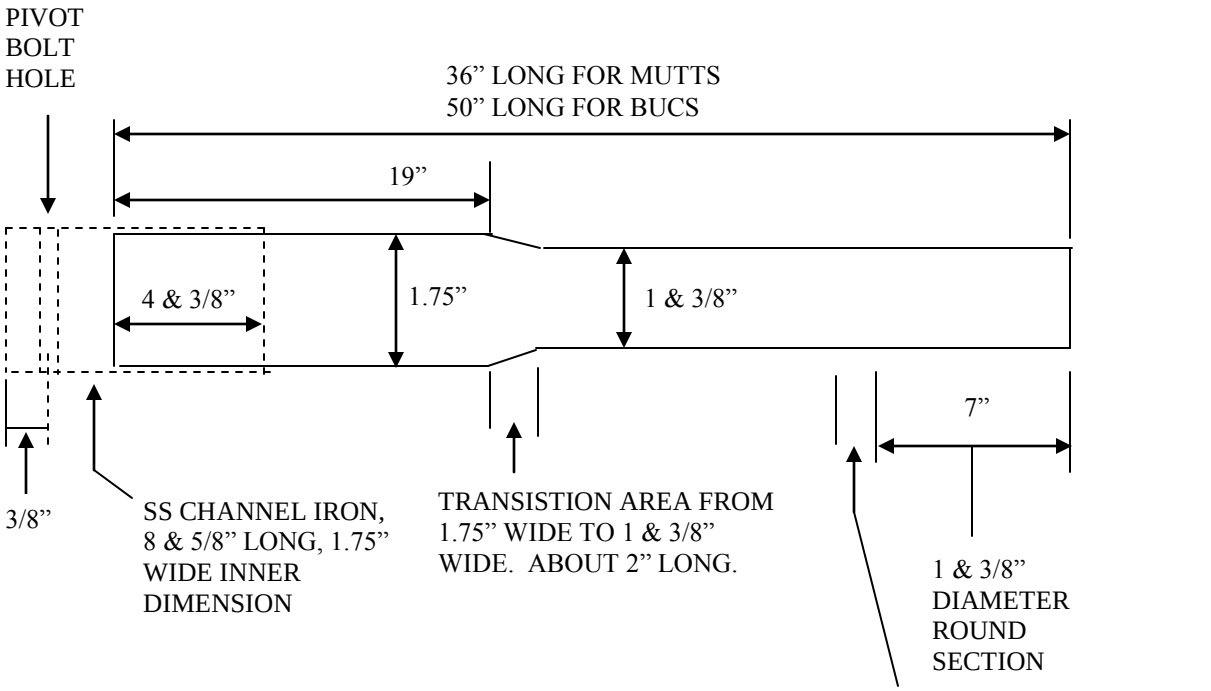
Lower Pintle (top view)

ATTACH THE OTHER 3 LOWER PINTLE STRAP FASTENERS THE SAME AS SHOWN FOR THIS ONE.



Tiller Drawings Note, drawings are not to scale.

TOP VIEW



SIDE VIEW