Installation of Raymarine 6001 Linear Drive Autopilot

This is a summary of the lessons learned installing the Autopilot in *Sea Dragon*.

Once I decided that *Sea Dragon* should have an autopilot, I had to select a unit. I began with a simple list of my requirements and began my search at the Annapolis Sailboat Show.

Requirements:

1. Capable of maintaining course in heavy seas with a fully load boat;
2. Serve as an emergency steering should *Sea Dragon* experience primary steering failure;
3. Modular parts that are readily available worldwide;
4. Integrated with other instruments onboard *Sea Dragon*
5. Reasonably priced if possible.

System Selected:

1. Raymarine 6001 Control Head
2. Raymarine S1G Core pack w/Flux Compass
3. Raymarine type 1 Linear Drive
4. Raymarine Rudder Position Sensor
5. Edson Bronze Autopilot Tiller Arm (926-10-24) bored to 1.5” w/ a 3/8” key way cut in the cap
6. Navpod (Power Pod, Rail Mount Small)

Installing the Core Pack and Flux Compass

My first step was to find place to mount the flux compass and core pack. Using a handheld compass I investigated several locations suitable for mounting the flux compass. I wanted to find a location that was near the center of the boat.

To accomplish this I walked around the boat with a hand bearing compass, looking for deviation/movement. If I saw any deviation/movement, that location was eliminated. If there was no compass deviation/movement, then that location was acceptable. Before starting this process I powered up everything that might cause a magnetic field, such as Stereo, CD Player, VHF, SSB, Radar, Instruments, refrigerator (N/A on *Sea Dragon* today), etc..

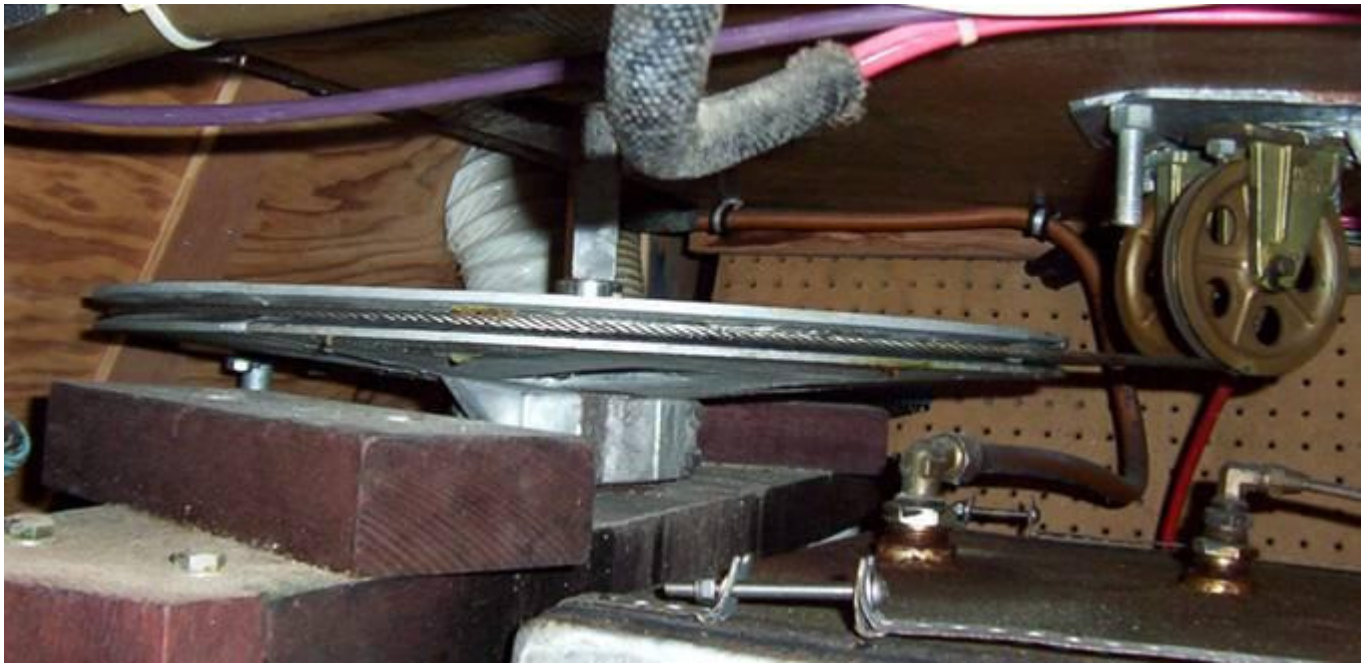
I settled on the front of the trash compartment next to the icebox for the compass’s new home and the rear of the compartment for the core pack.

Installation of Flux Compass & Core Pack on Sea Dragon

Tiller Arm Installation

Next came the Tiller Arm. Installation of the tiller arm was more complicated than I expected. First the dish shape of the radial drive left little shaft available for the tiller arm. The radial could not be lowered for two reasons:

1. No space and;
2. Lowering it would cause the cables to rub on the top of radial and chaff.



Radial w/ factory rudder stops in place

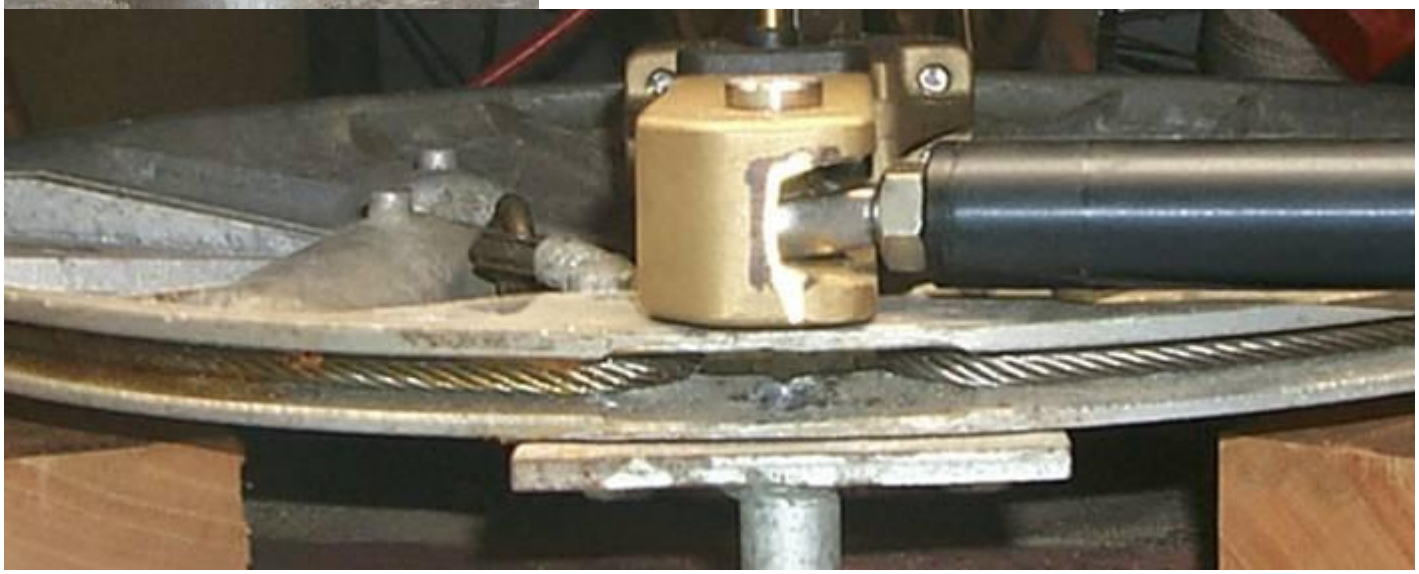
A few quick measurements showed that if the arm is mounted directly on top of the radial the arm extends only 3/8” beyond the round portion of the shaft. That still left 1 ¼” of shaft/tiller arm, I could live with this.

Tiller arm overlap with the keys in place.

On *Sea Dragon* the radial / shaft key did not extend all the way to the top of the key way so a small piece of 3/8” key had to be cut and fitted above the original key.

The existing key is extended by adding a small piece to fill the keyway.

Now with this problem solved another problem raised its head,

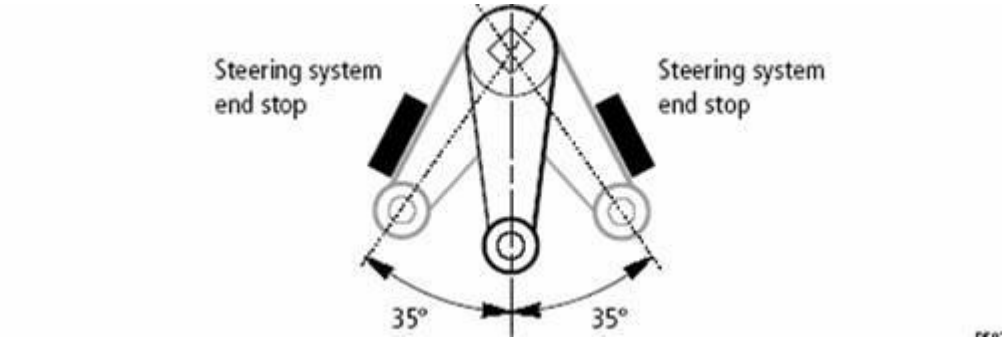


“there was no space for the clevis pin's cotter pin to lock the tiller arm to the linear drive”.

So I decided to drill through the radial.. This would allow me to keep the arm tight against the radial and still be able to lock the drive arm in place.

Drilling through the radial and allowing the clevis pin to pass though the tiller arm as well as the radial solved the problem.

With the tiller arm in place, I began measuring the angle that the arm moved with the factory stops in place. Sea Dragon moved approximately 55^{o} in each direction or approximately 110^{o} stop-to-stop. However, the Raymarine manual called for the stop-to-stop angle to be limited to 70^{o}(35^{o} each direction). I was concerned about he loss of 20^{o} of rudder movement in each direction so I decided to wait until I had the linear drive installed to install new rudder stops.



Recommended steering end stops

Installing the Linear Drive Unit

Next, I needed to decide where I should locate the linear drive unit. I determined that the aft bulkhead was a great location for the drive unit. Using a hole-saw and a drill, I cut an opening for the linear drive to pass through the bulkhead and connect to the tiller arm. As luck would have it everything lined up (well at least on the second try you may notice that there 8 holes instead of 4 as you would expect).

While everything lined up well using the existing bulkhead, I was concerned that it was not strong enough to support the 650 lbs of force the linear drive is capable of producing. I decide to reinforce the bulkhead with ½ inch marine plywood epoxyed and bolted to the existing bulkhead and finally tabbed into the hull. I was concerned about the forces in both directions so I modified the bulkhead design to distribute the force along the hull and cockpit.

The reinforcing plate was cut to include a vertical extension that was equal to the depth of the cockpit

The ½" marine plywood reinforcement for the starboard bulk head cut and ready to be installed in Sea Dragon.

Note the vertical extension that will fit against the cockpit wall.

Before installing the bulkhead reinforcement I first sealed the edges with epoxy so that if any water got in between the tabbing it would have a more difficult time getting into the wood and weakening it. Next I mixed batch of epoxy thickened to the consistency of peanut butter and spread it onto the new bulkhead. Using seven (7) 3/8 stainless steel bolts and C-clamps I pulled the two (2) bulkheads together until the thickened epoxy squeezed out all edges.

Note the vertical extension extends
above the existing bulkhead (yet to be tabbed)

The bulkhead reinforcement bolted and epoxyed in place
but not yet tabbed to the hull.

The next step is to tab the ½ plywood tab into the cockpit and hull.

The bulkhead was then tabbed into
the hull with two (2) layers of fiberglass cloth.

A little paint is added.

With everything aligned, an 1/8 stainless steel backing plate is added to back side of the linear drive mount to better distribute the load.

Installing the Rudder Stops

With everything in place the new rudder stops could be added. I measured the maximum travel and using C-clamps I positioned the new rudder stops.

The new rudder stops were cut to be about 3.5 inches longer the factory installed blocks. Then, using the same attachment points and hardware they were installed.

To make installing the new stops easier, I clamped them in place and used a 90-degree drill and the original holes to drill the new stops.

Once everything was in place I had 40^{o} of travel in each direction or a total stop-to-stop angle of 80^{o}. This is somewhat less than the original 110^{o}, but enough.

Installing the Rudder Position Sensor

The first step in the installation of the rudder position sensor was to disassemble the tiller arm take it home and drill and tap it and mount the tiller pin to Raymarine specs.

I dug around in my scrap wood pile and found a piece of mahogany that was just the right size to raise the rudder position sensor so that the linkage is properly aligned.

Then using a hole-saw and a drill I cut a circular piece from the scrap wood about the same size as the base of the unit. It was then drilled for mounting.

Installing the Control Head

The final task was to install the control head and wire all the components together. I purchased the Navpod Power Pod, Rail Mount (Small) in order to mount the control head at the helm.

To mount the Navpod unit, I first removed the guard and drill a large hole in the sole of the cockpit where the wires from the control head will penetrate the sole. Next I filled the hole with un-thickened epoxy. Once it cured I drilled a smaller hole to pass the wire through. This way, should water get into the guard it will not be able to get into the core of the cockpit sole.

Here I made a huge mistake. I used un-thickened epoxy thinking it would fill all of the voids better. It may have, but un-thickened epoxy drips and a small bump of the foot will cause it to spill from its resting place and make a mess. I have not been able to cleanup this mess to this day. In the future I will always use thickened epoxy.


AUTO
23°