**Purpose:**

Overall the plan is to mount everything to the winch using magnets so that the entire rig can be mounted easily and without any modification of the winch.

The main purpose of the following is to do a trial mounting the brackets for drive shaft encoding and fairlead sheave encoding and determine what dimensions, if any, need changing. These brackets are the only ones where dimensions are somewhat critical. The other sensors, such as the one for sensing the engine manifold pressure and rpm, don’t have any critical dimensions when it comes to the mounting.

Note: the stud magnets for the three fairlead bracket posts were unscrewed and cling together with the drive shaft enclosure. This was done for shipping since if they were left screwed into the bracket posts there would be a noticeable effect through the bottom of the shipping box as these magnets are rather strong. Screw the three magnets into the bottom of the bracket; the nuts/washers are embedded in the posts. (With the embedded nuts there isn’t an issue of over-tightening, whereas on the top of the posts I used self-tapping screws to attach the electronics enclosure and the threads are easily stripped (requiring a longer screw the next time, etc. I may change to embedded nuts if this becomes troublesome.)

**A. Drive Shaft Encoder**

Basic scheme: Two halves of the encoder wheel bolt together to clamp around the drive shaft with four 6-32 bolts with nylon locknuts. The electronics with the photodetector pair mount to the tongue on the transmission frame with magnet studs (see sketch).

Reflective photodetectors are used on this version. Interrupter type photodetectors could be used, but the pc board was designed to mount the reflective type directly. When it comes to dimensional tolerances for this application there isn’t much difference between the two types. If there are problems with the reflective type (either electrically or mechanically), then a switch to the interrupter type can be made.

The reflective type of detector has the photocell detect light reflected from the led in the same package (whereas the interrupter type has the encoder segment pass between the opposing led and photodetector). The plastic lenses have a very short focal length. The main application for these is to sense the presence/absence of a sheet of paper.

The datasheet for the QRD-1114 has a curve showing the effect of the distance between the photodetector and sensed surface. The detection curve peaks at about 35 mils (0.8 mm) and falls off with the response at 0.3 around 100 mils (3 mm). Net-- for best detection the gap is small.

<http://www.mouser.com/ds/2/149/QRD1114-1011865.pdf>(page 6)

If the encoder wheel scrapes the bottom of the enclosure, the stud magnets can be partially unscrewed to raise the bottom of the enclosure. The washer & nuts are captured in the plastic. Though somewhat loose when partially unscrewed, the magnet studs will not rotate when they cling to the metal frame so unscrewing from vibration would not be a problem.

**B. Fairlead sheave encoders**

Basic scheme: a three-post frame mounts to the fairlead side plates with magnets. An electronics enclosure housing two pc boards mounts on top of the frame. The enclosure has two rectangular holes for the photodetector pairs to “see” the encoder disc segments. Encoder discs mount to the ends of the sheave shaft ends with larger (25mm dia) stud magnets. The encoder discs pass under the electronics enclosure and the segments of the discs pass by the photodetector windows.

The gap between the encoder disc and the bottom of the enclosure has the same requirements as the drive shaft encoder. The rim on the encoder disc is 0.5 mm wider than the segment and this assures the minimum spacing between the segment the photodetector.

Adjustment of the gap can be increased adding spacers between the frame and the electronics enclosure. Some 3D printed washers of various thicknesses can be made.

Similarly, reducing the gap can be made by adding washers between the encoder disk and the magnet.

Item-1:

The magnets are 25 mm dia (nominal) and need to centered on the sheave shaft end. Before putting the magnet on the shaft end it might be good to put a small amount of lubricant on the shaft end. These larger magnets really “stick” and usually have to be slid off, rather than via a straight pull, and a little lubrication might help.

Item-2:

Be careful with these big magnets. They can pinch fingers. One magnet can sometimes pick up another magnet off the table at a significant distance, e.g. 6 inches and depending on how one is holding it get a nasty pinch or blood-blister,.

**C. Measurements—do the parts “fit”**

Here are the dimensions that I think are critical. (There may be other problems I missed!)

**1. Drive shaft encoder**

Mount the encoder wheel on the drive shaft.

a. Diameter for clamping to drive shaft encoder wheel?

Is it too tight, or too loose on the drive shaft?

The wheel can be re-printed with the diameter dimension modified.

b. Location of shaft balance weight cutout.

Does the drive shaft balance weight match the cutout hole (diameter) and if so when matched up there should be about 1/8” between the encoder wall and the mounting lip over the drive shaft.

If the distance to the encoder wheel wall from the mounting lip is too large, then the photodetector window in the electronics enclosure won’t “see” the segments when the enclosure forward mounting magnets are at the lip-edge. Obviously, if it is too close it rubs the transmission mounting lip.

c. Diameter of encoder disc

With the enclosure mounted on the transmission lip, the rectangular window in the enclosure should see the segments of the encoder disc .

The outer diameter of the encoder wheel should just touch the bottom of the enclosure when the magnets are fully screwed in. Unscrewing them a little should allow the encoder wheel to turn without scrapping.

Similar to the encoder discs for the fairlead there is a 0.5 mm ridge on the drive shaft encoder wheel that assures that the gap is not too small.

**2. Fairlead encoders**

The frame should be half-way between the two bearing blocks, and the very small raised ridge on the bottom cross bar marking the center should be in line with a line between the two sheave shafts. The two posts that are close together go on the side closest to the fairlead rollers. (The only reason for specifying this orientation is that I have a tiny “breather” hole in the bottom edge of the electronics enclosure to drain any moisture/water should be accumulate, and the frame orientation puts that hole on the bottom.)

a. Spacing

Do the encoder disc segments pass by the photodetector windows (i.e. is the diameter of the encoder discs and spacing between the two bearing blocks correct)?

b. Gap

Similar to the drive shaft—does the enclosure need to be raised, or the disc raised, (or are the dimensions too far off for minor adjustments)? Small adjustments can be made with washer shims, (but re-printing the parts is not a big deal).