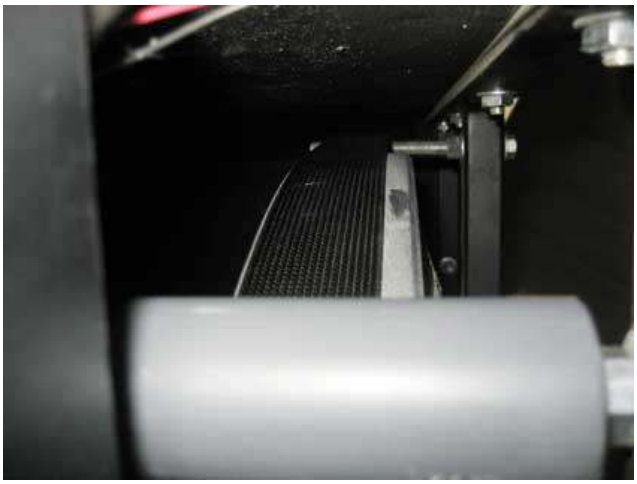
Wire Sling Assembly
by Jim Fitch

The traditional web sling has some disadvantages in a large scope. Ideally the sling would support the primary in the center of the mirror box without creating any astigmatism. Easier said than done. The sling must support the mirror at its center of gravity along the edge. The sling should not pull forward or backward on the bottom of the mirror. The sling cannot stretch or the mirror will not be held at the center of the mirror box.

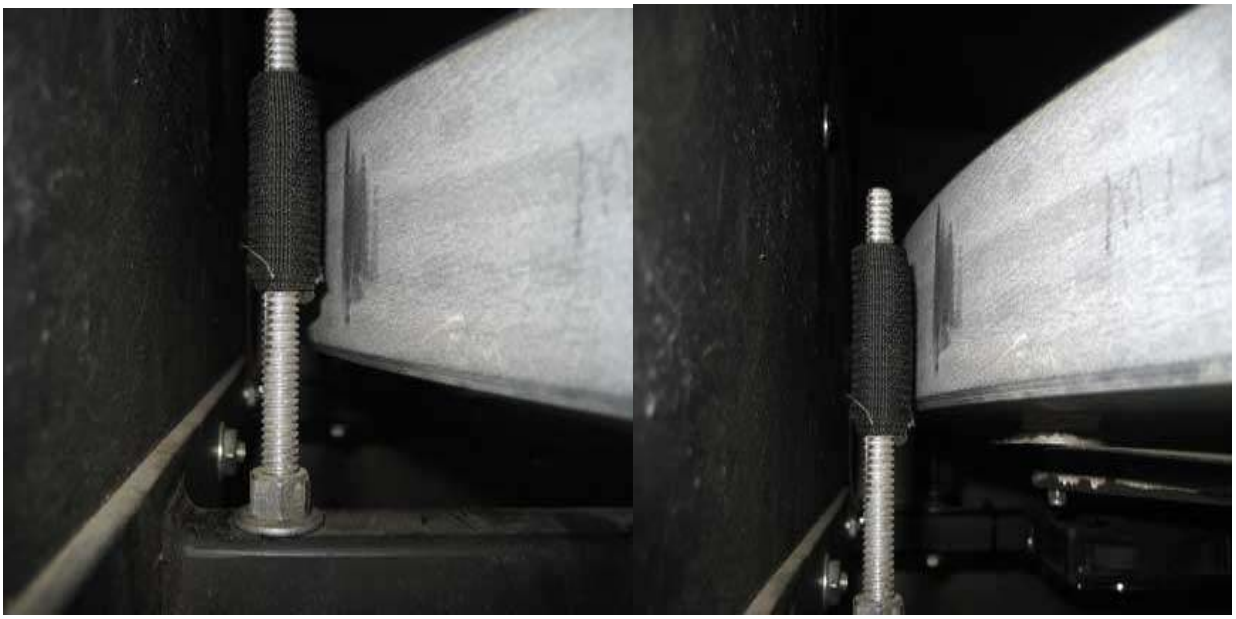
My 30” f/4.2 Pyrex mirror weights a little over 100 pounds. If the webbing stretches under that load, the mirror will not be held in the center of the mirror box at all pointing altitudes, leading to collimation problems. I could see significant shifting of the mirror from stretching of the webbing. In fact, when the telescope was pointed at the zenith the strap would trap the mirror tightly against the top safety bumper, causing complex optical abberations as well as collimation issues.

The 100 pound mirror is 2 inches thick. If the sling does not support the mirror at its center of gravity the mirror may bend, slumping forward or arching backward. I could not keep the strap at the mirrors’ center of gravity. I tried using duct tape to keep the webbing from sliding off the edge when the mirror was pointed at the zenith, with limited success.



The photo shows that the strap is positioned forward of the center of gravity. This allows the mirror to bend forward, increasing the curvature of the vertical axis of the mirror. The increase curvature of the vertical axis compared to the horizontal axis creates astigmatism at focus.

If the mirrors position changes during collimation the strap may pull on the edge.The following pictures illustrate the extremes of the problem.



The left photo shows the strap relative to the mirror when the collimation bolt is screwed all the way out (mirror closest to the tailgate). The picture on the right shows how much the strap position changes relative to the mirror when the collimation bolt is screwed all the way in. Both of these situations pull on the bottom of the mirror, either forward or backward. This torque causes a slight bending of the bottom of the mirror compared to the top which results in astigmatism at focus.

I decided to redesign the sling to avoid stretch type shifts as well as center of gravity and torque problems. Stretch can be avoided by using wire rope as the sling material. The position of the wire rope can be held at the center of gravity by placing adhesive Velcro on either side and capturing it with a mating piece over the wire.

This left torque as the remaining problem. I had seen a linear bearing used to resolve this problem on a telescope at Okie-Tex. All I needed to do was find a way to implement the idea. I used aluminum bar stock to make the bearing shaft holders. My idea was to bolt the shaft supports to the mirror box tailgate. There are other ways to do this, but they required more expense or harder to get parts. The photos show how I configured the bar to fit the tailgate.

Bar Stock

Milling the Bar Stock

Finished Shafts and Supports

I used stainless steel shafts for the bearing to slide on. The photos show how the shafts are secured to the aluminum supports. The aluminum supports are placed over the tailgate rail and held in place by a bolt that replaces the original split bolt. A linear slide bearing is placed on the stainless shaft and the wire rope is secured to the bearing. The plastic cover over the bearing spreads the load on the bearing so it rides smoother.

Assembled unit bolted onto the Tailgate

Another view of the Assembly

Final Assembly with Bearing Cover

The unit appears to work. Last weekend I was able to view the Eskimo Nebula at 995x and wished I had a higher power eyepiece. I'm pretty happy with the outcome. The following link should let you see a short video demonstration. The video begins with the mirror collimation bolts all the way out and shows how the mirror support follows the mirror edge as I turn the bolt to the full "in" position.

To see a video of the mirror adjustment in action go to:
http://vimeo.com/35896661