Meade Superwedge Modifications

by Danny Cobb

INTRODUCTION

I purchased a used Meade Superwedge expecting it would have excessive slop and backlash. However, the price was right and I did not want to wait months for a Milburn Wedge. The Superwedge did not disappoint; it had plenty of slop and backlash. On first inspection, the major problem areas identified were:

(1) Excessive clearances for the two 1" diameter bars for latitude adjustment. The recesses that hold the ends of the bars allowed for considerable movement.
(2) Undesired movement of the azimuth thrust bar (the short 1" diameter bar on the azimuth adjustment threaded rod.) The pin on the end of the thrust bar measured 0.250" in diameter. The slot in the tangent arm on the tripod head was less than 0.252" wide. This is about as tight as you would want, but still introduces some backlash. Much worse, is the tendency of the thrust bar to rock side to side and fore and aft due to the loose fit of the threads and movement/deflection of the threaded rod.

I read the experiences of others who have been kind enough to post their modifications on the web before coming up with a game plan of my own. You may want to visit these sites:
http://easyweb.easynet.co.uk/~chrish/lx_swmod.htm
http://www.valleytranscription.com/astro/

I have used the Meade terminology in this article. Please refer to the Superwedge instruction sheet if you are not familiar with the terminology.

GOALS

I wanted the modifications to:
(1) Not require any machining on the wedge itself. I don't have a drill press, so I did not want to drill out any holes and install bushings in order to tighten up clearances. Bushings are a more elegant solution, so if you have the inclination, go for it.
(2) Require a minimum of custom (i.e. machined) parts and make them simple to machine.
(3) Get rid of the backlash and slop so the wedge will work as designed.
(4) Make wedge set up and adjustment a tool free operation.

MATERIALS

I purchased the following materials from McMaster-Carr (www.mcmaster.com). I received my order via UPS Ground the day after I ordered it. Needless to say, I was quite impressed!

3 ea	61125K47	Comfort-Grip Star Knob 5/16"-18 Stud, 1.50" Stud Lg., 1.52" Knob Dia	$1.48 each	$4.44
2 ea	61125K58	Comfort-Grip Star Knob 3/8"-16 Stud, 1.75" Stud Lg., 1.91" Knob Dia	$2.06 each	$4.12
1 pk	95630A245	White Teflon Flat Washer 3/8" Screw Size, .380" ID, .812 OD, .027" Min Thk	$4.45 10-pk	$4.45
1 pk	91755A23	Nylon 6/6 Retaining Washer 5/16" Screw Sz, 9/32" ID, 47/64" OD, .062" Thk	$3.55 100-pk	$3.55
4 ea	5909K31	Steel Needle-Roller Thrust Bearing Cage Assy for 1/2" Shaft Dia, 15/16" OD	$2.05 ea	$8.20
8 ea	5909K44	.031" Thick Washer for 1/2" Shaft Dia Steel Needle-Roller Thrust Bearing	$0.68 ea	$5.44
1 ea	6085K31	Coarse Finish Aluminum Four-Arm Knob W/Stud 1/4"-20 Thread, 1-3/4" Stud Length	$3.87 ea	$3.87
1 ea	92510A769	Aluminum Unthreaded Round Spacer 1/2" OD, 1" Length, 1/4" Screw Size	$1.44 ea	$1.44
			Total Cost	$35.51

Other needed materials which I had on hand, but which can also be ordered from McMaster-Carr or obtained locally:

2 ea	3/8"-16 Hex Head Cap Screw, 2" Long (partially threaded)
1 roll	Stainless Steel Shim Stock, 0.0015" thick
1 ea	Teflon Sheet, 1/8" thick (6.5" diameter piece required)
1 tube	White Lithium Grease (or other grease for the bearings)

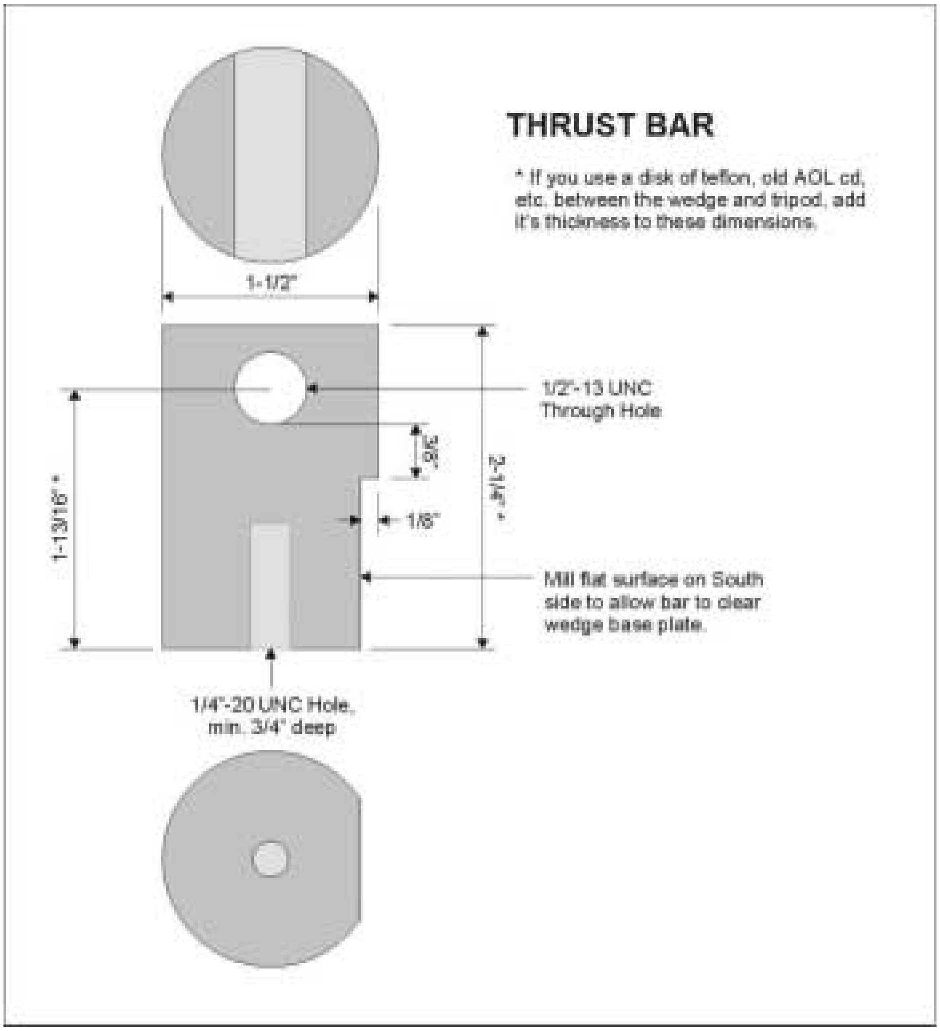
You can use thinner teflon, but adjust the dimensions of the thrust bar accordingly. Others have reported success using a disk cut from a margarine tub. CD's tend to crack and are not recommended.

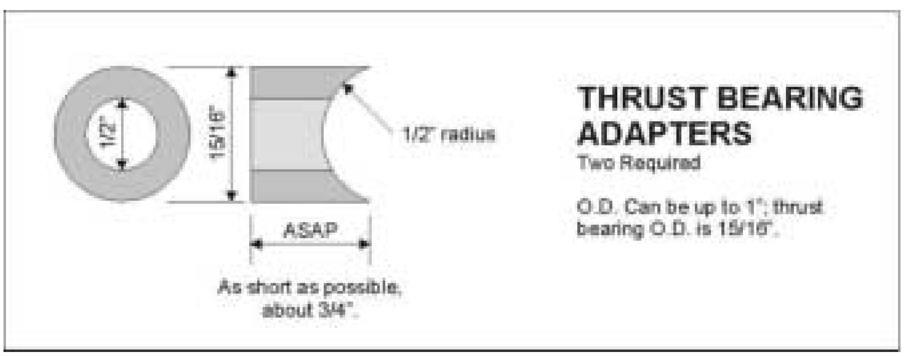
If you want to install knobs in place of the tilt plate attachment screws (the uppermost screws), I would recommend getting two 3/8"-16 x 3" long studs and two knobs with blind threaded holes. The studs have an unthreaded center portion, ¾" nominal length. Cut off one end of each stud to leave ½" of threads. Install the cut ends of the studs in the knobs with Loctite. This will put a full 3/8" diameter, unthreaded surface in the holes in the wedge side plates to avoid slop. (You will not need the hex head cap screws if you make these knobs.)

If you're ordering from McMaster-Carr, you may want to order additional thrust bearings for the focuser upgrade described by Scott at:
http://members.cts.com/nebula/s/scottb80/focuser.htm

MACHINED PARTS

I had three pieces machined. Two are identical bearing adapters used to provide a flat surface for the latitude adjuster bearings. The other piece is a new azimuth thrust bar. Any machine shop should be able to make these for you based on the below drawings. I was able to obtain these pieces at no cost, so I'm not sure what the actual cost might be.





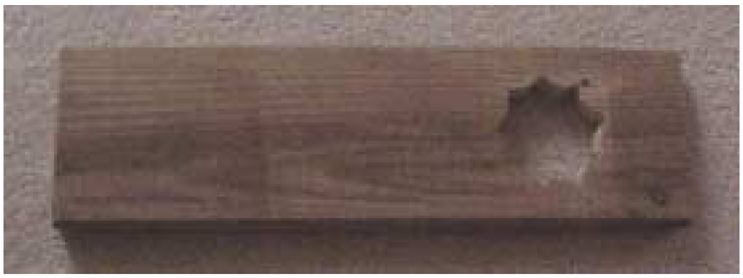
My thrust bearing adapters, which each add about ¼" length to the stack of parts on the altitude adjuster, limit my lowest latitude setting to approximately 27 degrees.

My machined pieces are made of brass. Stainless steel or a good grade of aluminum are other options. The bearing adapter pieces might possibly be made from hardwood or a scrap of Corian.

TOOLS

For the most part, only common hand tools are required: Allen wrenches, ¾" open end wrench, scissors.

You will likely need to fabricate 2 spanner wrenches to remove the azimuth control knob(s). I used a couple of 5/4 boards about 2 feet long. You can use whatever is handy. I used the manual knob that secures the wedge to the tripod as a template to trace an outline near the end of each board. A little work with a drill and jigsaw produced a couple of wrenches that did the job, although they are not pretty. A scroll saw would have worked better if I had one.



MAKING THE MODIFICATIONS

Once you get all the parts and tools, the modifications don't take long.

Step 1 - Disassemble the azimuth adjuster.
Remove the acorn nuts located against the azimuth control knobs (hold the knob with a spanner and remove the nut with a ¾" wrench.) Suitably situate the wedge and use the fabricated spanner wrenches to remove one of the azimuth control knobs. The knobs have Loctite applied to the threads and it takes a fair amount of force to loosen them. One knob with break free first. Remove it, the nut and the thrust washers. Turn the remaining knob to back the rod out of the azimuth thrust bar, then completely remove the azimuth adjusting assembly.

Step 2 - Remove the tilt plate.
Back off the double nuts and unscrew the fine latitude control knob assembly from the wedge. Remove the attachment screws and tilt angle adjustment screws, then remove the tilt plate.

Step 3 - Disassemble the wedge body.
Remove the vernier pointer assembly from the side of the wedge with the latitude scale. Turn the wedge over and remove the hex socket cap screws which hold the wedge sides to the base. This will allow the wedge to come completely apart.

Step 4 - Shim the 1" bars on the latitude adjustment mechanism.
Cut four strips of the shim stock about 1/2" wide and 24" long (scissors work fine.) Coil the strips around your finger, then pop them into the recesses/holes which hold the ends of the bars. The shim stock will uncoil and conform to the recess/hole. Test fit the bars, making sure to orient the parts just like they will be positioned when reassembled. The bars should not fit at first. Pull out the end of the strip of shim stock and trim off a couple of inches. Test fit again. Repeat until the bar just fits the hole or recess.

Step 5 - Reassemble the wedge
Reattach one side of the wedge to the base. Put the 1" diameter bar (the one with the unthreaded hole) into position and reattach the other side of the wedge. You may want to add a film of grease to the bar ends to facilitate smooth movement. Alternately, wrap with teflon tape.

Step 6 - Reinstall the tilt plate.
Place the 1" diameter bar back into the tilt plate. Lightly grease the bar ends if desired, or wrap with teflon tape. Attach the upper pivot point with the two hex head cap screws: place a teflon washer under the metal washer for each screw; place one or two teflon washers between the wedge sides and the tilt plate to fill the gap; lightly grease the unthreaded portion of the screws. Attach the lower end of the tilt plate with the 3/8"-16 knobs: place a teflon washer on each knob stud; place one or two teflon washers between the wedge sides and the tilt plate to fill the gap. The hex head cap screws can be tightened enough to eliminate any unwanted movement while still allowing for latitude adjustment. With my wedge, the unthreaded portion of these bolts fit snugly in the holes in the wedge side plates. If yours have excess clearance, you can either shim the holes or wrap the bolts with teflon tape. Leave the tilt plate set for highest latitude for the time being.

Step 7 - Reinstall the latitude adjustment mechanism.
First, go ahead and pack all the needle roller thrust bearings with grease. Clean off the excess grease and put a thrust washer on each side of the bearing. Place one of the original thrust washers on the threaded rod, convex side towards the knob. Then add one of the needle roller thrust bearings (with its washers.) Then add one of the bearing adapter pieces. Insert the threaded rod through the lower bar with the unthreaded hole. Then add the other bearing adapter, another thrust bearing, the thrust washer, and the two nuts. Run the nuts down to snug everything up. Thread the rod into the threaded hole in the other bar. Tighten the two nuts, but do not overtighten. Replace the vernier pointer assembly.

Step 8 - Reinstall the azimuth adjustment mechanism.
Cut two more strips of shim stock and shim the holes in the wedge sides to reduce the excess clearance for the threaded rod. Do not make this fit too tight or the threaded rod may screw the shim out of position. Put one of the original thrust washers onto the azimuth adjuster threaded rod, which should still have a knob on one end, with a nut to the inside. Then add one of the thrust bearings with its washers. Insert the threaded rod assembly half way and then start threading it through the azimuth thrust bar. Once the bar passes through the other side of the wedge, add the bearing and thrust washer. I simply double nutted the end of the rod. If you want to reinstall the knob on this side, you will need to break both knobs loose, and reduce the amount of threaded rod protruding to the outside of the knobs, or you will not have enough length due to the addition of the bearings. Replace the acorn nut(s).

Step 9 - Cut the teflon sheet.
Cut the teflon sheet to fit the tripod head, including the center 1/2" hole and three 3/8" holes. Tip: First drill the ½" center hole. Then use the ½" O.D. spacer as a spindle for cutting the circle. I put the spacer in a shallow ½" hole in a scrap board, which I clamped across my router table (spacer down.) Then I rotated the teflon past the spinning router bit for a perfect circle. The 3/8" holes for the 5/16" knobs are centered 2-9/16" out from the center of the disk. P.S. – Teflon machines like butter.

For those after the ultimate solution, a thrust bearing for the wedge to tripod junction is described by Cliff Peterson at:
http://www.mapug.com/AstroDesigns/MAPUG/WedgMods.htm

Step 10 - Install the wedge on the tripod.
Place the teflon disk on the tripod head, then mount the wedge to it using the manual knob. Add four of the nylon retaining washers to each of the 5/16"-18 knobs, then install them instead of the original 5/16" hex socket button head cap screws. The washers are required for the knobs to clear the cast rim on the wedge base plate. Adjust the vertical position of the tangent arm on the tripod head to provide a little clearance between it and the azimuth thrust bar. Place the round spacer on the stud of the aluminum knob and screw the knob through the slot in the tangent arm into the thrust bar. By allowing a slight clearance before this

knob is tightened, the thrust bar slightly loads the threaded rod when the knob is tightened. This eliminates any play and the resultant backlash.

CONCLUSIONS

Fortunately (?) cloudy weather prompted me to make my modifications before ever using the wedge. However, since I use the wedge on my tripod as a field set up, I wanted the wedge to be easily and accurately adjusted. Just toying with the unmodified wedge indoors made me curious as to how anyone could easily achieve accurate polar alignment in the field with such a wedge.

The redesigned thrust bar also makes mounting the wedge to the tripod much easier since there is no pin to align with the slot in the tangent arm.

Initial use after the modifications proved satisfying. Using a 5mm reticle eyepiece as a gauge, I could make controllable, repeatable adjustments on the order of 10-15 arc seconds. Adjustments in one axis did not measurably affect the other axis.

When making the coarse azimuth adjustments, the knob securing the thrust bar should be left loose to allow the bar to slide fore and aft in the tangent arm groove. My design focused so heavily on preventing backlash, I did not pay attention to the fact that the thrust bar moves significantly when making major azimuth adjustments. This oversight did not turn out to be a problem since leaving the knob loose allows for the needed movement. Once the azimuth is close, the knob can be tightened since the thrust bar movement becomes insignificant.

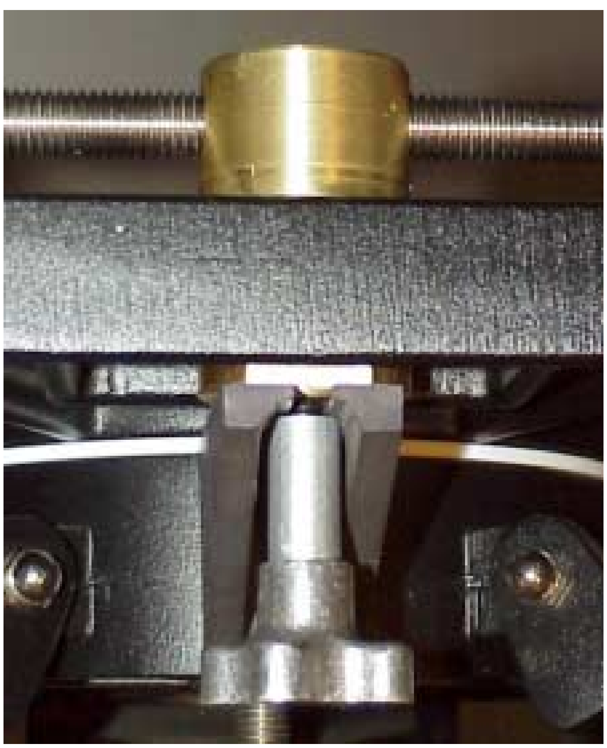
PHOTOGRAPHS

A picture is worth a thousand words, so…

The thrust bar assembly from underneath.

Knobs for attachment to tripod. Edge of teflon Disk is also visible. Note that I omitted one of the azimuth adjuster knobs.

Altitude adjuster. The steel thrust bearings appear white in the photo. At the top right, teflon tape wrapped on the fixed bar prior to insertion in the shimmed hole is visible. At the top center, a slight ring of shim stock can be seen where the moving bar penetrates the tilt plate.



Thrust bar and knob. The bar is 1/8" longer than the original to offset the thickness of the teflon disk. The spacer on the knob just fits the flat surface on the underside of the tangent arm and extends the knob so it clears the tangent arm. The flat surface milled on the thrust bar reflected the camera flash and appears bright.

THOUGHTS FOR THE FUTURE

Since the same threaded rod secures the tripod spreader and the wedge, loosening the wedge's knob to allow for azimuth movement also reduces the force of the spreader on the tripod. Adding a ¾" O.D. x 1" long x ½"-13 threaded spacer in the hole through the tripod head would allow the spreader to be tightened independently of the wedge. However, for this to occur, the threaded spacer must be locked to the tripod. An interference fit would lock the spacer in place, but then it could not be removed when using the scope in alt-az mode. Cutting keyways in both the spacer and the tripod head would prevent the spacer from rotating and allow for removal, but the wall thickness of the spacer won't accommodate much of keyway, not to mention the required machine work. A set screw installed in the underside of the tripod head is another possibility for locking the spacer in place.