**The Meade Infinity 102 AZ**
**Altazimuth Refractor**

**A Review by Bill Steen**

September, 2014

This review is in response to feedback I requested and received on an article submitted to Cloudy Nights on my thoughts on the two new lines of Meade entry level scopes, the Infinity Altazimuth and Polaris Equatorial series. After a few weeks, I received a cryptic email from Meade telling me that an Infinity 102 AZ Refractor and a Polaris 130 Equatorial Reflector were being sent to me for my review, with no other words. So I am flying a bit blind.

**About me:**

In my working life, I am a registered professional mechanical engineer with a 45 year career in the power industry. I currently travel to seven power plants as an internal company consultant in areas of internal water quality and combustion processes.

My original interest in astronomy started when I was about seven years old and a neighborhood friend received a Gilbert 3-inch reflector of dubious quality. I asked for a telescope for myself and was told that telescopes were very expensive. I shelved the thought, unfortunately too long. About eleven years ago, my wife noticed that I watched all the astronomy shows that came on TV, even though I might have seen them many times, and suggested that I should get a telescope. That definitely opened a door! I currently have many telescopes, most of which are small, beginner models that I have either purchased new, found in garage sales, or were given to me. Several have had an abusive former existence. One of my primary astronomical interests is taking these scopes, fixing and/or improving them, and seeing how far I can push their performance.

I am a member of the Astronomy Club of Tulsa, though not very active at the present time. For health and work reasons, my astronomy is limited mostly to an hour or so after dark from my back yard or from the vicinity of a hotel when I am traveling as part of my job. I live in a dark red zone, as shown on the most recent Dark Sky Map, and most of the hotels where I stay are roughly in the same condition. I am a moderator on the Meade 4M Community Forum and a former small Meade stockholder before the company was purchased by the Sunny Corporation.

I know nothing about the new parent company, other than bits and pieces I have read on the internet. I have no knowledgeable contact with any of the other subsidiary companies of Sunny and do not know if any of the telescope products that I already own have been manufactured by them, even though some may.

I currently have cataracts and am nearing the time when I will have new lenses installed. This condition limits my observational abilities to some extent. Please keep this in mind when I state what I can see or not see as it relates to bright or detailed objects.

**The nature of the product and this review:**

Since the Sunny subsidiaries did not spring into existence with the purchase of Meade, their products had to be sold to other distributors. This includes products or parts of products included into the two new lines of Meade telescopes. Since the nature of the new telescopes, as I understand it, is fairly generic to entry level scopes being sold around the astronomy market, this review is being offered with the idea of it being a possible look at a scope like this regardless of what company name is on it. However, the particular combination of parts may be different. The combination of features discussed in this document, in my mind, only applies to this particular model as offered by Meade.

The Infinity 102 is designed, built, and sold as an entry level scope. Going into this, I am confident that what has gone into the scope is based on the needs of a beginning astronomer. One of those needs is to keep the initial price down, while maintaining necessary astronomical attributes. This review is being done with that mission for the telescope in mind. Answering the question, "Does this telescope meet the needs of a new astronomer?" is the primary goal. A second question, "Does this scope provide an appropriate value to the astronomer for the price paid?" A third question is, "What can be reasonably done by the customer to improve the scope?" The reasons for the third question are: Some of the things that might be desirable from the customer's viewpoint are not reasonable for the manufacturer to do for an entry level scope and still keep the price down. I want to give the reader an idea of what might be done to improve the performance or adaptability of an entry level scope. Some people dismiss entry level scopes, looking at what they originally receive, rather than what the possibilities with the scope are if only the person used imagination and a little effort to make some changes.

Some of the modifications I am going to discuss may not be what is best for the scope in terms of wear over the long term, such as using very heavy eyepieces with it. However, they do show what a person can do if so inclined. There are many possibilities if we only open our eyes and look for them. We can do a lot with simple things if we want to.

In this review, I go into detail on a lot of little things. The document may be long and tiresome for some people. (Please accept my apologies.) This is the only way I know to truly explain what I see and let the reader decide if he/she agrees with my opinions.

**Initial Inspection and Setup:**

Since I received two different scopes, I decided to open only one scope at a time, review it, then open the other. The idea is to keep from overloading myself with the various details and getting things mixed up. The first box is the Infinity 102 refractor.

The main box with the color printing did not have any lavish Hubble pictures printed on it, nor were there any outlandish claims made. The box simply stated that the scope was intended for terrestrial, lunar, and planetary viewing. An accurate listing of contents inside this box was clearly printed on the outside.


Removing the mount and tripod, I found it to be fully assembled, other than having to fit the accessory tray over the short central post of the leg brace and rotate it into place, locking the three outside tabs of the tray into their retaining slots on the legs of the tripod brace.

Next was the optical tube, which fit on the top of the mount on a rubber treaded surface. A captive bolt is then screwed into the appropriate hole in the dovetail plate on the scope, using a hand wheel attached to the mounting bolt. Then, the slow motion control knobs, finder, diagonal are attached. The eyepieces and Barlow go on the accessory tray…..done!

They included two nice but plain wrenches (one double ended, fitting 8, 12, and 13 mm I think), a small Philip's head screwdriver that truly fits the scope's Philip's head screws, and a triangular piece of flat metal that is engraved with the word, "screwdriver" on it. I did not need any of those, at least for initial assembly. I later found that I needed the little flat screwdriver to tighten the retaining thumb screws on the fine adjustment control knobs to get them acceptably tight on their shafts.

The instruction book is a black and white pamphlet with good, to the point, simply written instructions and advice…..well done! Also included is a copy of the latest revision (5.53) of the AutoStar Suite program for the Windows operating system. I have 5.50 loaded on my computer, which is the planetarium type program that I use most often, now that I have colors and other options in it set up to my satisfaction.

Just to verify the stated weight, I stepped on my bathroom scale, checked the weight, picked up the scope, saw the new weight, set the scope down, checked the weight again. The whole rig does weigh about twelve pounds as stated.

## The Optical Tube

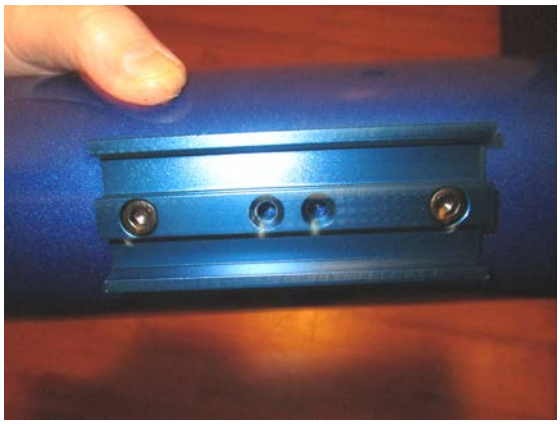
The optical tube is specified to be 102 mm in diameter with a focal length of 600 mm. Casual measurement indicates that the clear diameter is 102 mm with a liberal amount of extra glass for holding the lens in place. The objective is an air spaced doublet with three evenly spaced separation pads. The anti-reflective coating looks bluish green in color to me and appears to be evenly applied.

The dew shield and the lens cell components are tough black plastic. The dew shield has a dull surface and extends about three inches beyond the objective lens. The lens retaining ring threads operate smoothly and are not cemented into place, allowing easy access to the objective lens and interior of the tube if needed. The retaining ring inside surface is shiny black and the inside surface of the objective cell appears to be shiny black as well. However, effects of the lens may be giving a false impression to the inside cell surface. The cell is held to the tube with four evenly-spaced screws, the ends of which can be seen extending maybe an eighth of an inch into the tube.

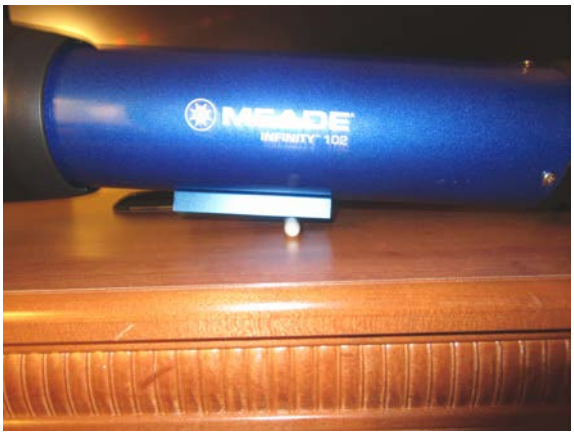
Both the inside and the outside of the tube appear to be well painted, Meade blue on the outside and flat black on the inside. Looking through the objective, three baffles can be seen. The tube itself is non-magnetic, probably an aluminum alloy.

The focuser seems to be well built and strong for this level of scope. Even though written descriptions indicate it is 1.25 inch, I find it to be two inch, with a 1.25 inch adaptor. The focuser seems to be made of metal, probably an aluminum alloy. Upon testing, the focuser can handle a 2 inch diagonal and at least a Meade 5000 24 mm UWA. Since there are no claims by Meade that the focuser can handle two inch eyepieces, the longevity of the focuser or at least internal padding may be questionable. However, inspecting the interior, the pads look to be good enough for two inch eyepiece use. The focuser operates smoothly, if a bit stiff with even a 30 mm UWA, better than an Antares FOCR2 focuser that I own and use with the same eyepieces and diagonal on a modified DS 2102 optical tube. Without question, this is the best focuser supplied with an entry level scope that I have experienced.

The cast-in finder bracket located on the left upper side of the focuser, upon testing, accepts an Orion 6X30 Correct Image Right Angle Finder and Bracket, as well as the supplied red-dot finder.



The dovetail on the under side of the optical tube has two standard mounting holes drilled in it and either may be used. The dove tail mounting bolts are just that, socket headed screws that are large enough to require a nut and maybe a washer inside the tube, rather than what look like small wood screws that are normally used in this function.




When the focuser is extended to the appropriate position for an eyepiece to be in-focus, the lens cover is removed, and the diagonal in place, the center of gravity of the whole optical tube assembly is roughly one inch to the rear of the rear mounting hole. Even when the optical tube is mounted as far forward as it can on the supplied mount and tripod, the scope is rear heavy with no eyepiece or diagonal in place. This rear weighting is not a problem when using the supplied eyepieces and diagonal, but with significantly heavier eyepieces this could prove to be a problem, depending on just how heavy the eyepieces are. For an entry level scope, I believe this is acceptable.

Tightening the nut on the altitude shaft can allow the use of a heavier eyepiece, but movement in the vertical direction becomes stiffer. I did this and was successful at using my 24 mm UWA, but had difficulty moving the scope around due to this stiffer vertical movement. Without the additional tightening of the altitude shaft, the scope and mount worked well with my 1.25 inch UWA eyepieces. I think it is safe to say that the system can handle 1.25 inch eyepieces of any reasonable size including Meade's HD 60 eyepieces and others similar in size as it comes out of the box. This is definitely good enough for an entry level scope.

## Accessories

The **red-dot finder** is substantial and solid. The on-off dial under the front screen has intensity adjustment plus a click-stop when the power is turned on or off. Unfortunately, the finder cannot read my mind and turn itself off when I am through. One of the first things I did was run the battery down. The horizontal and vertical adjustment knobs are

easy to locate and use. The screen is larger than what I have normally seen with entry level scopes and is easy to use. The red dot itself appears to contain several small dots in an asymmetrical pattern, forming a bit of a point toward the upper right of the dot. I believe someone could use this point to indicate the centering spot in a way that would allow the red dot to be an arrowhead pointed at a dim star, rather than covering it. This could allow the use of a shorter focal length eyepiece as the starting point when viewing double stars or other small objects.


The **MA design eyepieces** appear to have all plastic bodies with a rubber eyecup in focal lengths of 26, 9, and 6.3 mm. Though light in weight, the plastics used appear to be very strong and stiff, rendering them very operable. The barrels, though somewhat light, appear to be metallic, polished smooth, and chrome plated. The lenses are well ground and have a standard AR coating rather than the multi-coatings of more expensive eyepieces. All three seem to have an apparent field of view of about 45 degrees since they are quite comparable in width to my UO HD orthoscopic eyepieces. The 26 mm and 6.3 mm eyepieces supplied are parfocal, with the 9 mm having a focus position far enough outward that it is obviously not parfocal with the other two.

The two smaller eyepieces were supplied in strong and relatively rigid plastic cases having flexible vinyl lids and no end caps. The 26 mm eyepiece came in a plastic bag with both normal end caps. The 26 mm is a little too big, I think, to fit into one of the plastic cases, even though I would prefer for it to come in a case like the other two.

The appearance of the **2x Barlow lens** is deceiving. The body is all plastic, light weight, and gives the impression of something very inexpensive. However, the plastic used has good properties, holding the lenses where they need to be. The lens itself proved to be good, limited only by the standard anti-reflection coating and its two element design. The tube length is longer than a “shorty” Barlow. I attempted to use it in front of the diagonal for additional magnification, but I could not bring the scope to focus.

Other than two super Plossles that were supplied with one NG 70 refractor I purchased, the eyepieces and Barlow supplied here are the best I have personally experienced with an entry level scope. Possibly someone with better vision can see differences that I cannot, but the only reason I would have to use the usual multicoated Plossles instead of

these eyepieces would be to have the benefits of a better coating or a wider field of view. As it is, I find the eyepieces comfortable to use, which is unusual for me with supplied entry level eyepieces. However, someone that must wear eyeglasses to see properly through a telescope would need something besides these.

One big surprise to me came in a small package. That was the **diagonal**. Everything about it, except for the optical portion is plastic and very light weight. The descriptions I have read say the mirror is an erect image diagonal. What it seems to be is an Amici diagonal, or something very similar, giving the view a correct orientation rather than left and right being in reverse. Due to its light weight, I was reluctant to put any truly heavy eyepieces in this 1.25 inch diagonal. However, I did try them and did not sense any problems. There are plastic orifices on both inlet and outlet ends of the diagonal. On the eyepiece end, the barrel of the eyepiece rests on the orifice. In the case of the Barlow, it is long enough that the whole thing cannot go into the diagonal and maybe a half inch sticks out of the diagonal that would normally be inside.

Though I like the diagonal, which is pleasant to use, the prism is almost too small. With the 26 mm MA, the edge of the view is not crisp. I believe there is a bit of vignetting. It is more apparent when I used a 5000 series 5-element Plossl with its 60 degree apparent field of view. I will continue to use the diagonal, even with a little pinch around the edges of the view. Having the view oriented correctly is nice. Even though I have had three different diagonals with me when I have used the scope, Amici, mirror, and prism, I seem to instinctively go back to the Amici. I think this item will be an asset for a new astronomer.

One characteristic that this diagonal has, as compared to pictures I have seen that were taken through an Amici diagonal, is that there is no horizontal white line going through bright stars. When attempting to star test the telescope with this diagonal in place, the image of an inwardly defocused star looks normal. When taken outwardly defocused, there is a thin dark vertical line running slightly to the left of the center of the star. Therefore, I am not sure this is truly an Amici, even though I am calling it that.

## The Mount

The **mount** itself seems to be well designed for its assigned task. There are five cast aluminum pieces and a bunch of smaller parts that make up the mount. The **top-most section** contains a captive bolt in a long slotted piece with a rubber treaded surface that the scope is attached to. There is a surprisingly effective handle screwed into the rear end of this slotted piece. The handle has a backing nut that secures the handle, keeping it from rotating in one's hand, if the nut is tightened correctly. This upper section can be removed by loosening nuts on two downward pointing bolts that are captive but internally loose in ends of the slotted piece. Removing the slotted piece allows the holes in the tee section below it to be used for mounting rings if a person so desires. However, the use of the handle will be lost as it is attached to the slotted piece.

The second section, a tee shaped piece, involves **altitude** movement, both fine adjustment with the control knob just to the right of the OTA, and course adjustment using the handle on the top section.

I found a lot of back lash in altitude gross movement, moving the handle up and down. I wasted a lot of time figuring out what to do because I overlooked one little screw. I suspect that as the mount wears in, adjustments to some things will be necessary, so here is what to do:

Move the scope up and down, with the optical tube mounted, using the handle. If this moves very easily, it will not hold up as much weight in terms of diagonals, Barlow, eyepiece, camera, etc. If the movement is too stiff, then the whole mount and tripod mechanism has to flex like a spring a little bit before actual movement starts. An easy movement will most likely be good enough for the eyepieces supplied, but I tightened mine up a bit, just to make sure. If the movement seems a bit too stiff, loosen it up. The way to do that is to tighten or loosen the altitude shaft nut that is located on the left side of the mount. It is very obvious in the picture above. It is one of the two largest nuts you will see on the mount. There is no supplied wrench for this particular nut. Before the nut, is a lock washer, then the nut itself is a lock nut, and some thread cement is applied to the bolt threads. The maker apparently does not expect or intend for the user to adjust this, and that may end up being the case. I would not make an adjustment here unless there is a real need.

Look through the eyepiece at an object and make a vertical move with the handle. If there is an easy movement at first, with the image moving, then stiffer movement, then a reverse movement that matches the first easy move, there is some back lash, which will more than likely involve a mechanical adjustment with the altitude slow motion system to remove it. This backlash may not show when moving the slow motion knobs.

With all the rear weighting on the mount, the likelihood of having any backlash showing up with the slow motion altitude control is very remote. But, if you have to turn the slow motion control knob more than just a few degrees before the objects start moving in the view, there is some backlash in the slow motion controls.

The first thing to check is a threaded sleeve that the knob end of the worm gear shaft goes through. It has a lock nut on it between the control knob and the fork that holds the worm gear. Look to see if the worm gear shifts back and forth any before it starts rotating. Normally, if this is happening, the knob will turn very easily. If this happens, then the little threaded sleeve that the worm gear stem goes through is too loose. Remove the slow motion control knob, loosen the stop nut on the little sleeve, and screw the threaded sleeve in a little bit. I used a pair of pliers on the outside-most thread on the sleeve. Tighten the stop nut, re-install the control knob, and try again. Keep doing this until turning the knob gets harder, then maybe back off a tiny bit. The idea is to keep enough pressure on the ends of the worm gear that it cannot move back and forth when the control knob is turned. A little additional stiffness in the control knob should insure that the worm gear is held tight.

The next item is the little plastic shuttle that moved back and forth on the worm gear as the control knob is turned. There is a little adjustment screw on top of the shuttle piece that makes it tighten down on the worm gear (visible in the picture above). If that is not tight enough, the worm gear can move some without the scope moving. You can tighten the little screw with an Allen wrench. I am sure it is a metric size, but a 3/32 inch Allen wrench worked for me. Tighten the screw just enough to stop the play in the slow motion control knob and no more. Excessive tightening will make the knob action stiffer and will wear out the shuttle threads faster.

On my scope, I had enough play in the gross altitude movement that, when I lifted the handle, the image would move about a third of the 26 mm eyepiece's field before the altitude shaft moved, and then would settle back the same amount after I released the handle. The issue ended up being a loose shuttle on the worm gear, requiring maybe one full turn to tighten. Now, it works very well. I have everything tightened up a little too

tight right now, expecting things to wear in a bit and loosen up. If it the movement does not loosen up on its own in a week or so, I will loosen it up myself.

The one true manufacturing defect that I encountered involved the azimuth slow motion control in the next section down. The final outcome was some extraneous machining material under the far end of the azimuth worm drive, probably from when the end hole was drilled in the retaining fork. A little lip was pushed out from the normal aluminum surface. I expect that proper tension was set when the mount was at the factory, but as the worm drive was used, the extra metal deformed in a way that made the azimuth knob hard to turn and also freed up clearance on the worm gear from end to end. The result was about a quarter turn of backlash on the slow motion control knob and a stiff action when turning it. Working the knob back and forth repeatedly, plus adjusting a threaded sleeve that holds the worm gear in place, eventually machined the extraneous metal and small flakes of metal came out around the far end of the worm gear. After a lot of working the knob and adjusting the threaded sleeve, the azimuth fine adjustment worked well with a maximum of 30 degrees of knob movement in backlash. I took the worm drive apart, found no more debris, but polished the suspect area with 400 grit sandpaper before re-assembling the worm gear. It still had about 30 degrees of backlash which may be good enough and not diminish the experience, but I wanted a little better. This last thirty degrees ended up being “on me” because of not getting things back together correctly after taking them apart.

Again, after some study, I figured out there were three adjustments for the azimuth controls as the altitude controls. Some of the details are different, but the procedure is reasonably the same.

The little sleeve that adjusts the worm gear movement and resistance is the same as the altitude. But the adjustment for tension on the shuttle works differently and the nut on the azimuth shaft is on the underside of the mount. With a little space between the washer on the bottom of the fork and the shuttle itself, tightening the screw causes the shuttle to pull downward on the worm gear, taking all the play out of the threads. Just a little downward pull is all that is needed.

Looking from the rear of the scope, with the optical tube horizontal, I could see the section of the mount that the azimuth lock knob is on was sloping down toward the worm gear, or left side, and up on the lock knob or right side. I do not remember it being that way when I did a pretty good inspection. I believe I did not get things quite back like they should be after I looked inside the lower part of the mount.

The only way I could see this happening was if the azimuth shaft nut was too loose. However, I felt I needed to be careful. If I pulled down hard on the azimuth shaft nut to straighten up that section, I would put a lot of force on the azimuth slow motion worm gear shuttle. There is a screw going into the bottom of it, with a washer on the screw, which is actually the tensioning device for the shuttle's backlash. Therefore, I unscrewed the screw about an eighth of an inch first. I then backed off the azimuth lock knob on the right side to free up the azimuth gross movement.

I then, started tightening the azimuth shaft nut underneath the mount and swiveling the mount around with the handle. As the azimuth shaft nut was tightened, the movement would be difficult at first, and then it would loosen up. I would then tighten the nut a tiny bit more and work the handle some more. Eventually, the parts evened out with movement being smooth and just a little bit stiff.

I re-installed the azimuth slow motion control knob, which I had removed, and started turning it one way, then the other. I could visually see a little delay in the shuttle. I started slowly tightening the screw on the bottom of the shuttle until that delay stopped. I then started looking through the telescope as I moved the control knob. I had to make one more tiny adjustment in that bottom screw in the azimuth shuttle to remove the last of the back lash.

Since I left both the altitude and azimuth shaft nuts a little too tight, there is a tiny bit of spring type motion when I make a gross move to either. I expect to have a little more wear-in with the mount and this movement should stop. If not, I will loosen things up a tiny bit.

So, what are this backlash, wear-in, and adjustment all about? Well, here is my take on it. On an entry level scope, they simply cannot afford to do all the machining and polishing that is done with a high dollar scope. Therefore, there will be some wear-in and adjustments by the user that are necessary to make it perfect or nearly so. Is this really necessary to enjoy the scope? No, just makes it a little nicer.

I have a couple of thoughts about the situation just discussed. I was a little disappointed to find the defect in the azimuth drive and the play in the altitude being as much as it was. However, I was very happy to find adjustment capability available and (for me) easy to find once I opened my mental eyes and looked. I am not used to having such capabilities in an entry level mount and normally have to get creative to find a solution. I do think some form of instructions should be supplied for making adjustments when the need arises.

As an entry level mount, I think this one is cleverly designed, using an adequate material in each part with no excessive overkill in materials anywhere. It is easy to use and certainly gets the job done. The one true manufacturing glitch in the azimuth slow motion control was easily corrected. Having some things off a little, requiring occasional adjustment by the user as the scope wears in, is a necessary part of an entry level scope. I give a "thumbs up" to this mount's adjustment capabilities. This is a good light weight mount, which I believe will be very reliable, easy to use, and effective for its designed mission. Using two inch heavy eyepieces is clearly outside the mount's design envelope, but can be accomplished I think with some help and a willingness of the owner to allow extra stiffness in vertical movement. If stiffness of movement is not tolerable, then stick with 1.25 inch eyepieces or spend a few to many hundred dollars on a better mount.

## A Word about Grease

There is a kind of grease that all beginning astronomers learn about and manufacturers seem to love. The version used in this scope seems to be a lighter material and not quite as sticky as I am use to on other scopes. It is used on the focuser rack and the two worm gears on the slow motion controls. Due to positioning, there is not much likelihood of getting it on one's hands from the worm gear, since the control knobs are what are touched. Since the handle on the mount is so convenient, there is not anywhere near the likelihood of getting on fingers when moving the scope for gross movements.

The inside of the mount is loaded down with the material and my advice, based on experience, is to stay out of there. As the mount is worked, a little will find its way through the various seams between sections of the mount. The only time this bothered me was when moving the scope around by grabbing the mount.

Once in a while, a rag with a little soap and water may be useful in keeping this under control. As the scope is used the amount working its way through the seams decreases.

## Tripod

The **tripod brace and accessory tray**, which links to it in multiple places, work together to form the strongest bracing system that I have experienced in an entry level scope. The material is a high quality, strong plastic of adequate thickness to do some good. As an experiment, I placed first a ten pound hand weight, fifteen, and finally a twenty pound weight on the assembled tray, with only minor deflection. The only improvement I can recommend to the manufacturer is more eyepiece holes, maybe in a slightly larger tray. I like this setup a lot.

The **legs** are made of tubular stainless steel, with the fittings at both ends and a joint in the middle, being made of the same tough plastic as the brace and accessory tray. At the joint between the two portions of each leg, there is a single thumb screw for fixing the leg position.

Due to the nature of stainless steel tubing, it acts more like a spring more efficiently than either wood or aluminum. Most entry level scope now use stainless steel tripod legs with some being better than others. When I pulled the forks of the ends off the legs for activities discussed below, I found the inside of the tubes and the seam weld smooth. To me, this means the tubing is well made in a structural sense as necessary for this telescope. I have seen other telescopes where the inside of the tube was rough and gaps existed to some extent in the seam weld, even though they were not visible from the outside. I saw none of this in the tripod tubing of this telescope.

With the way the tripod and other components are made, the only appreciable vibration or wiggle that I could sense was torsion related, around the vertical axis of the tripod. Though other forms of vibration have been effectively dampened, there is nothing on this tripod to dampen or prevent torsional movement other than what is naturally occurring in the legs themselves (and maybe two plastic spacers on the altitude shaft). Having no deliberate bracing to resist vertically oriented rotational movement in the tripod is normal for any tripod, even expensive ones. The more expensive tripods overwhelm wiggle with shear weight and strength of the regular parts. This approach is simply too expensive for an entry level scope.

For this tripod, any dampening mechanism for torsion on the outside of the legs would most likely prove cumbersome, ugly, or inconvenient and thereby would decrease the enjoyment of the customer and sales for the maker.

In order to gage exactly how much vibration or wiggle is experienced with this telescope, I set up an experiment with a stop watch to actually time how long it took for wiggle to go away after several different normal actions. I am calling this **wiggle time**. Starting the stop watch is fairly easy when I turn loose of a knob, but knowing when to punch the button at the end of an event is a bit subjective, so I did it five times with each activity and took an average. The activities included: Focusing the telescope in an inward direction, focusing the telescope in an outward direction, fine adjustment of altitude in upward and downward directions, fine adjustment of azimuth in both directions, gross adjustment of altitude in either direction, and gross adjustment of azimuth in either direction.

The results are as follows:

Focusing the scope, either in or out: 0.8 seconds
Fine control movements in any direction: 1.8 seconds
Gross movements in any direction: 1.8 seconds
Significant tap to the side of the focuser with finger tips: 2.1 to 2.5 seconds. (not normal)

For normal activities, I think keeping wiggle time less than two seconds is acceptable for an entry level scope, which this one does. As a side note, going through the mount to find back lash ended up hurting the wiggle time for focusing. I am not sure what I did wrong, but later checks showed the focusing wiggle time to be the same as the other normal activities.

**Operating the Telescope:**

### Setting Up

For my scopes that I keep ready to go, I leave them set up with eyepieces and all the necessary other equipment. For refractors, I leave the scopes pointed straight up. If there is a possibility of gravity slowly pulling on the plastic and taking the objective out of collimation, this is an attempt to keep the forces around the plastic lens cell even. For most of the mounts, I can simply lift up on the leg brace, let the legs move inward, and easily carry the scope outside. With this scope, having the eyepiece tray locked in place and eyepieces in it, this is not possible. I found closing up one of the legs allows me to walk down a hall or go through a doorway without scraping the leg tips on something.

Once outside, I simply re-extend the leg and set the scope down where I want it. I then pull off the lens cover and go get my astronomy chair, reference material, etc. By the time I get back with the chair, the temperature difference between the scope and the environment has stabilized and I can start viewing.

I then turn on the red dot finder. Assuming I remembered to turn it off the last time I used it, it should not need any attention. I check to make sure the azimuth lock knob is loose, and then turn the scope toward the first object using the handle. There is no need to pull on the focuser or anything else! I can then go down on one knee and sight in the red dot finder where I think the object is. If it is something I can actually see in the sky and I do not have to guess at its position, the object will be in the field of view of the 26 mm eyepiece and probably the 9 mm if I wanted to put it in first for some reason.

### Viewing Overhead

When viewing overhead, there are three conflicts that I noticed. Two are common with mounts of this nature, but I thought I would mention both of them. The third is simply a result of me being a bit picky, but is noteworthy since I end up viewing nearly straight overhead a lot.

The first item encountered is the telescope tube coming into contact with the azimuth slow motion knob…not a big deal. I mention this only with the idea that, as a nice but unnecessary improvement, when/if the manufacturer has to build a new casting mold, which they do from time to time, it would be nice if the whole azimuth worm gear mechanism were shifted maybe 15 degrees or so around toward the front of the mount. Then, the azimuth control knob would angle outward and not come in contact with the tube. For this particular mount, I will try a control knob with a longer shaft.

The second item is that the handle on the mount swings down and goes over the spot where the closest eyepiece hole in the accessory tray is located. With the 6.3 mm eyepiece is in the hole, then the handle goes right over the top of it, just barely. The handle hits the rubber eyecup on the 9 mm eyepiece, and the body of the 26 mm. I reserve that spot for the 6.3 mm eyepiece. Originally, the distance between the fork on top of a leg to the leg brace clamp measured 9 ¼ inches. I moved the leg clamps to lengthen this distance to 10 ½ inches, to gain what I think will be enough clearance between the handle and eyepieces.

I found that I needed to make sure the scope was positioned toward the mid point between two legs or slightly to the left. Otherwise, the altitude slow motion control knob gets pinched and the scope cannot move all the way overhead. This is not a complaint, just an operational observation of what the observer should do.

**Star Testing**

About the first thing I did, at first light with this scope was to star test it. I first tried it with the Amici diagonal and the 9 mm eyepiece on a bright star. Both the in-focus and out-focus positions looked remarkably good. Pulling out Bruce Suiter's Book, Star Testing Astronomical Telescopes, and using the illustrations for 0% obstruction, I found that the images I was seeing were at least as good or even a little bit better than the 1/8 wave error illustrations. Not believing what I was seeing, I went back and forth between the scope and book, tried other stars, other diagonals and eyepieces. What I found was that with the Amici diagonal, I was getting an indication of spherical error of a tiny bit better than 1/8 wave of under correction. When I tested using a mirror diagonal, the

spherical error was definitely better than ¼ wave of under correction, but definitely not 1/8 wave.

I then looked up Amici diagonals in Wikipedia and read the article there. Apparently, an Amici prism naturally has a little over correction in spherical aberration, which counteracts some of the under correction in the objective lens of my scope.

**What can I see?**

Viewing the moon with this scope is not quite as good as my 100 mm f/8 optimized refractor, which I did not expect it to do. But, it did do well for an entry level scope. I did not have as nearly as much trouble with glare as I expected. I was able to use the 6.3 mm eyepiece and 2X Barlow effectively and observe some "rubble" in the bottom and landslides on the sides of craters. I tried my 4 mm UO HD Ortho with the little 2x Barlow to get 300X. The image did not fall apart like I thought it might. The objects in the bottoms of craters were naturally a little bigger, but no more detail with the conditions at that time. Brightness and contrast diminished a little bit. The view was good, but I cannot say it was any better than at the 190X of the 6.3 mm MA and 2X Barlow.

Several days later, I tried with a nearly full Moon, using 4, 5, and 6 mm UO HD Orthoscopic eyepieces. It was really close, but I finally decided I could see a bit more detail around the southern edge of the Moon where there was still some contrast with the 4 mm eyepiece. Possibly, this is due to my eye condition. In any event, the view at the higher magnification was definitely good for an entry level scope. I then compared the views between my 6 mm Ortho and the 6.3 mm MA that came with the scope. Quite frankly, they looked the same to me. I know intellectually that the Orthoscopics are better, but I could not actually see the difference. Possibly, my cataracts are the reason. I think the little 6.3 mm MA is a pretty good eyepiece and a lot better than I had expected.

As the Moon brightened each night, I started to see a little more and more color around the rim. By the time this "super-moon" became full, I had a very apparent yellow green ring running all the way around the edge of the disk. I get a little of that with my f/8 100 mm refractor, but not as much.

When viewing Saturn near a four day old Moon, I could see the rings clearly, but only a slight hint of darkening where the Cassini Division should be. This is normal for me now with any scope, therefore I cannot be a good judge of critical viewing of bright planets at this time. It was nice to see the three lesser moons inside the orbit of Titan winking at me regularly. Moving Saturn near the edge of the field, the portion of the rings closest to the center of the field were a light rusty red and the outside edge was light blue. This chromatic separation was more intense with the Amici compared to a mirror diagonal. Apparently, the Amici improves spherical correction of my scope in exchange for more chromatic separation around the edges.

On an early morning adventure, I tried to view Jupiter, fairly low in the east. I have trouble with the brightness of Jupiter in anything but a 60 mm refractor. I was able to see

the two equatorial bands, but contrast was not good. This is normal for me and even better than I can see with my LS 8, due to glare. The dance of the moons was nice. I only got up to view Jupiter simply to say that I at least tried. Again, I cannot adequately judge what this scope can do with bright planets.

I looked for and found the Lagoon Nebula. I could definitely see the larger, brighter side and a definite vertical cutoff where the lagoon slices through the nebula. I could see that there was some nebula to the left of the lagoon, but it was very hard to define where it stopped and started. All the stars in the cluster were nice, as were the pairs of stars in sort of a path going to the west. This was viewed with maybe a four day old Moon from my dark red zone back yard at 36 deg North latitude. I thought this was doing pretty well for the conditions.

Viewing Epsilon Lyrae, the splits in the two sets of doubles was quite evident in the inside, let's say, 1.2 degrees of the field. In the outer 0.3 degrees of the field, I could not see the split. The Moon on that night was just short of first quarter, I think.

I did find the Ring Nebula, with the same moon as with Epsilon Lyrae. It looked like a fuzzy spot with a tiny hole in the middle. It was just about straight overhead, but I did not have much of a problem finding it.

A few days later, I tried to find the Crescent Nebula in Cygnus, but failed. The Moon was about five-eighths full and was probably too much. I have seen it plainly in my other 100 mm optimized refractor, but I wanted to see if it was visible in this one without any special treatment. I will try again later.

Mu Cygni was next. It is on the east wing tip of the Swan and is regarded by many as difficult to split. The primary is about mag 4.7 and the secondary is 6.1. The separation is 1.7 arc-seconds by the 2013 WDS Catalog. With a five-eighths full moon, stars were twinkling to about one third of the way between the horizon and zenith with Mu being 45 to 50 degrees up, and a hint of haze from humidity, I was not able to get a split. What I could see was two disks overlapped about 20%. One was light orange and the other light blue. I tried twice more, with one being at a darker location with about the same results.

I am not quite sure how to judge this result with Mu Cygni. Reading in Sissy Haas's book, the Dawes limit with the magnitude difference between primary and secondary is supposed to be 1.4 arc-seconds for a 100 mm refractor. Reading in Wikipedia, it says that the Dawes limit relates to the amount of split necessary for an observer to tell that there are two stars and not one….just an elongated disk. I believe, with this scope, I can detect elongation enough to tell if Mu Cygni was double with a separation of about 1.5.

If this was an f/10, I would think there should be a clean split and I would be disappointed otherwise. But since this is an entry level rich field achromatic refractor, I think this performance is reasonable when the observing conditions, etc. are taken into consideration. A scope with this low of a focal ratio will not have star splitting as a major strength. However, I want to let the reader decide.

I did manage to take the scope with me on a trip to one of my power plants, which has darker skies than where I live. I had only one evening with any clear sky at all for about an hour. I could see the Milky Way going straight overhead. There was some turbulence, but the sky was clear in the area I wanted. I was in a hurry to get the scope on Mu Cygnus again and just grabbed the first large eyepiece I touched in my bag to get things going. It happened to be my Meade 50000 26 mm Plossl, with its 60 degree field of view. For me, this creates a richest field scenario for a four inch scope, but I really did not think of that at the time. I looked through the eyepiece, thinking about spotting Mu and……..Oh Wow!!! I forgot about Mu for a few minutes and just stared. This is this scopes real strength! I finally got back to Mu and found the same as the first time.

At home, I do not even use the term rich field. With all the light pollution, there is nothing rich about it. It is all about taking what I can get. I call it wide field viewing instead. What I saw at the plant was definitely a rich field view. I have an even darker plant site I want to take the scope to, but will have to plan carefully. I normally need to stick around the hotel at night to make sure I can put in a full day the next day.

**So what do I think about this scope?**

1. I think it is an excellent beginner's telescope that can provide a good introduction into many different aspects of astronomy. The widest view with the provided eyepieces is good enough, even though a wider field of view would be nice. This is the first time I have seen an entry level scope that truly provides a full package to the beginner. Everything provided is quite usable. Though another scope will do a better job at specific tasks, such as a Polaris 90 viewing bright planets or splitting double stars, this one is able to do the various tasks well enough for providing the novice an introduction into the different activities within the hobby. (I cannot truly judge the bright planet scenario.)

2. The optical tube is already good enough for intermediate work of a wide viewing nature, whether rich field, open clusters, or brighter nebula. The mount can be upgraded with care to serve as an intermediate level scope for an observer on a limited budget.

3. I think Sunny is trying very hard to give good value for the money and they have succeeded. I think this scope is definitely worth the $250 price. I would buy one myself or would purchase one to give as a gift for children or grandchildren with no hesitation.

4. I certainly think there are things that could be improved. If not, then there would be no reason to purchase higher level scopes, like APOs, or higher level mounts.

5. This Infinity 102 is a keeper for my platoon, especially as a rich field scope, which is what it truly is, even though it can perform other tasks reasonably well.

6. I believe this scope can currently handle any 1.25 inch eyepiece under a half pound in weight. I would not want anyone to purchase this scope with the specific idea of using

two inch eyepieces in it. At this point, truly heavy eyepieces are only a possibility which is most certainly outside the mount's original design envelope.

7. The handle on the mount and the little Amici diagonal have spoiled me!

**Modifications:**

**Wiggle Suppression**

Even though the amount of wiggle is acceptable for an entry level scope, I thought it would be worth my time to explore what it would take to reduce wiggle time some. I tried setting a ten pound weight on the accessory tray and testing the wiggle time to see if there was any improvement, but I could detect none. Attaching a small amount of weight between the tripod brace and the upper-lower leg junction dropped the wiggle time to 1.7 seconds. This was in the form of two six-inch long by 3/8 inch bolts taped to each leg. I scrounged around for more weight and ended up taping screwdrivers, wrenches, eyebolts, etc. on to the legs with no more improvements. I then taped some strips of wood 1 1/2 inches wide, ¼ inch thick, and 36 inches long to each leg in three places. This dropped the wiggle time to 1.3 seconds on average.

Since I really did not think I could go around with bolts, wrenches, boards, etc. taped to the tripod legs, I decided to try something I had been thinking about for a long time with other scopes.

I removed the legs from the mount and the tripod brace, then, drilled out the two pop rivets holding the fork at the top of the leg to the upper tube material. With the fork end removed, I collapsed the leg to put the open end of the lower leg near the open end of the upper leg, and locked the set screw to hold the lower and upper leg in that position.

I purchased some ¾ inch poplar dowel rods and three copper solder adaptor fittings that were ¾ inch slip tube on one end and ¾ inch male pipe thread on the other. I cut the dowels to 23 inches, but will cut to 22 inches in the future. The bottom end runs into a pop rivet. I took tan plastic packing tape, which I think does not compress much and will not end up putting goo all over everything, and carefully wrapped it around the dowel about one inch from the top end, then one in the middle, then one at the bottom. The top end left about one inch of clear wood visible. The bottom wrapping ended up with an inch of wood visible there, but I will leave two inches in the future. I made a point of doing the spots in sequence from top to bottom to allow me to stick a particular wrapping into the lower leg and see how well it fit. I wanted each to be tight, but not so tight that I could not push the dowel down the leg. I needed to feel the tightness of a single wrapping without interference of another, so I did one end, then the middle, then the other end, to get a good smooth fit with some resistance.

Then, I pushed the dowel rods into the pipe thread end of the adapter fitting, stuck two dimes in the little hollow made by the tubing shoulder inside the adaptor that tubing is supposed to but up against. I put a nickel in on top of the dimes and shook the rig,

adjusting the wooded dowel position until the dimes would just rattle. Marking the position of the dowels on the outside with a pencil, I took things apart and glued the dowels in place, setting them aside to dry. The next day, with each dowel rod, I put in two dimes, then a nickel, then a penny, another nickel…..until the whole thing was filled up with just enough room for another dime on top. I then taped up the top with thin strips of the packaging tape going over that top dime, then another long strip going around and around the ends of the first strips. I will go back later, take off the tape, put a quarter on the very top, and tape that down. This will allow the top dime to slip back and forth and not be stuck to tape. If necessary, I will remove or trade coins to allow the top dime to move. The dimes are the most likely coins to slide around, with the others more likely serving as ballast.

The dowels were then pushed into the lower legs, through the upper until the copper adaptor was seated against the top flare of the lower leg. Then the legs were extended and thumb screw and re-tightened. The fork end was glued back on using Elmer's white glue, which is water soluble, instead of using new pop rivets in the heads. I leaned the extended legs up against the wall, fork end down, to keep glue from running down inside the tube and left them to dry for a day. This was in my garage that gets very warm in the summer and the glue dried completely…..I thought …before turning them right side up. I will let them dry for two days next time or use less glue. I had some glue ooze from the fork and run a few inches down the outside of the leg when I put them back in service.

I was hoping that the legs would collapse completely, but I had enough internal restriction that the legs collapse about an inch less than they did before.

After re-assembly, I tested the wiggle time again. It came out averaging about 1.1 seconds for every normal action. How much each part of the modification played in the reduction? I do not know.

What do I <u>think</u> this modification does to get the improvement? First off, it made the lower leg stiffer. The fairly soft poplar wood is pretty non-resonant and should render the lower leg vibrationally inert for any practical purposes.

The dowel itself added weight, but the copper fitting and coins added weight at a critical location, the middle of the leg. The lower end of the leg does not move, since it touches the ground. The upper end may have the most rotational movement being close to the axis of rotation, but it is supported by the mount and optical tube's mass. Tripod tubing in the middle of the leg and the accessory tray assembly can rotate around however it needs to with little restriction except for the eventual spring action of the legs. The junction of the upper and lower leg sections is where I had seen the most flexing taking place and felt that was the place to put the most suppression.

The coins will, hopefully, slosh back and forth some. If they slide downhill and rest in the curved inside surface of the adapter fitting, they may try to rotate when they move. The different coins also have different densities and diameters, accelerate at different rates, have different clearances in the copper fitting, and have different natural

frequencies either as they move across the inside of the fitting or as they rotate. (Think white noise.) They will slide across the surfaces of adjacent coins, creating friction which turns into heat (energy). The only source of energy for this heat is the vibration of the wiggle, so the wiggle decays faster than it would without the coins moving around as I think they now do…….I hope.

The fork piece must have some sort of clearance or it will not slide onto the stainless steel upper leg tubing. With the two pieces pop riveted only on the spot pointed toward the center of rotation, there is nothing to resist any movement of the tubing inside the fork in the tangential direction. The glue works first as a lubricant when pushing the two pieces together, then fills in the clearance completely and cements the two pieces together for a stiffer connection.

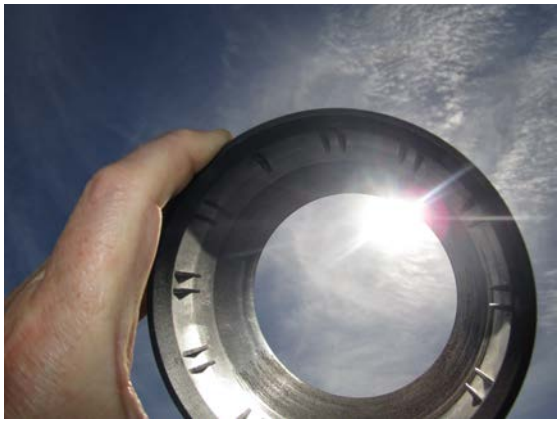
This is just my first shot at doing something like this. As it is, the wiggle time was decreased by around 40%. I doubt seriously that I hit the optimum combination on the first try, so a little experimenting could make the situation better. How am I going to get back into the leg to make changes? I used water soluble glue. Hopefully, I can extend the legs to get all the critical parts away from the fork end, then stick that end in a pan of water for a day or so and re-dissolve the glue. If I cannot get the legs apart again…well, it is really good enough and I will play more with the legs on another tripod.

## Lowering the Leg Brace Assembly

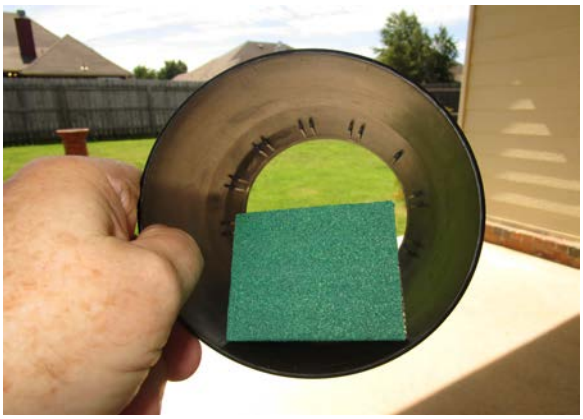
Most of the really interesting things that I want to view end up being overhead. This is also the best place for me to view, due to light pollution. In order to improve the mount and tripod's function, I dropped the tripod brace at least an inch and maybe more. The measurement of the exposed leg tubing between the fork at the top and the leg brace clamp was 9 ¼ inches. I increased this to 10 ½. This gives more clearance between the mount handle and eyepieces. It also narrows the distance between tripod leg tips, since the fixed distance between the leg brace clamps is being lowered, and makes carrying the scope down a hall or through a doorway easier.

## Glare Reduction

Even though there was a surprising lack of obvious glare in views from my back yard, I know from experience that doing what I can to remove reflection and light pollution potential will provide more contrast and allow me to see dimmer objects.



To reduce reflections from black parts, either shiny or somewhat dull, I did the following: I took a pad of 80 grit sandpaper and sand circumferential grooves that I call "pseudo threads" in the inside surface of the dew shield, the lens retaining ring. I normally do the inside of the lens cell, but opted not to this time due to its small area. Then, I carefully spray painted the pseudo threads with




Rustoleum Flat Black Primer. It is the combined flattest, darkest paint I can find. I sprayed the shortest bursts of paint that I possibly could, even though I missed some places. Then, after the paint has dried, I went back and got the spots I missed the first time. My goal was to not have any runs or places with paint so thick that it filled in the grooves.

The inside and shiny interior end of the focuser tube was spray painted. This may not be necessary, but I did it anyway. I do not want any reflections at all.

While I had the scope apart, I blackened the edges of the objective lens elements. I used a cone tipped medium sized "Sharpie" for this. It changed the whole characteristic look of the lens and helped improve Contrast. With light reflecting off that whitish surface being greatly reduced.

**Balance Adjustment**

Again, while the scope was apart, I moved the dove-tail toward the rear of the scope the width of the mounting bolt holes. I picked that distance to allow the use of an existing hole and only have to drill one new one. What I normally like to do with entry level scopes is move the scope forward as much as I can and not have the front end drop when the eyepiece and diagonal are removed. This allows the heaviest eyepiece possible to be used with the scope without

more extensive modifications. I found that the bolts simply made threads through the aluminum tube wall and did not actually have a nut on the inside surface. The tube material seems fairly thick. I removed the forward bolt, unscrewed the rear one enough to rotate the dovetail around, which made the original forward hole in the new rear one. I used a quarter inch bit to drill just enough to make a centered indention into the aluminum, using the dovetail as a guide. A bit maybe a $64^{th}$ of an inch larger would have been more fool proof, but I got a good center indention. I then used a 13/64 inch bit to drill the hole through. This was just right for the bolt to cut threads through the aluminum. The new hole came through just behind the last baffle. I then sprayed the inside of both the front and rear ends of the tube with my paint, since I wanted to cover up any scuff marks. I also think the Rustoleum is a bit blacker than the original flat black paint. Lock nuts will be added if needed (painted flat black).

With everything put back together, I once again tried the 24 and 30 mm eyepieces. As you can see in the picture above, the scope and mount can hold its own, stuck way out to the front, with a fairly tight altitude nut, and no diagonal or eyepiece in place. With the 30 mm UWA and two inch diagonal installed, the mount could hold its own with the scope in a horizontal position, but I could tell it was straining. When I took the scope beyond about 45 degrees, gravity took over and the scope would go vertical by itself. I then tried the 24 mm UWA and the mount was able to handle that all the way from horizontal to vertical…..just barely! Both seem to function well when I pull the scope around by hand, which is good enough for wide field viewing, about like large binoculars on a tripod, but using only one eye. Will all this last? I don't know! But, the view with the 30 mm is worth the risk. I expect trouble with the slide pads inside the focuser, the altitude worm gear shuttle, and possibly the holes the altitude shaft goes through over time. These eyepieces must definitely not be left in the scope except when actually being used.

With this setup, there are problems with the altazimuth slow motion control knob hitting the left focuser knob and the side of the optical tube. I tried a 12 inch knob, but that was in the way when I tried to use the finder. I now have an appliance knob in that place. The altitude knob gets pinched when the scope is in the vertical position, so I am trying the 12 inch knob in that location.

When I took the scope out to try the new knob configuration and just see what would happen with the large eyepieces in the scope, keeping the scope steady and in place was ok, but a down sloping counterweight shaft on the front side would certainly help. Both eyepieces worked very well. Even with the view with the 30 mm eyepiece, with a pupil diameter too large for my eyes, looked wonderful. I moved a bright star all around the field, trying to get a lot of coma, but could not. In my 100 mm f/8, which is top notch for high magnification work had badminton birdies where bright stars were supposed to be all around the outside 20% of the field. I did not have anything like that with this scope.

While I had the optical tube apart, I looked for good places to mount a second accessory shoe for a 6X30 right angle correct image finder. I prefer to mount it on the focuser, across from the existing, built in shoe, to keep the finder closer to the eyepiece. I found what I believe to be enough room between the focuser body and the focuser tube to accommodate nuts on the end of mounting screws. This would allow the use of a red dot finder on one side and a right angle finder on the other. I do not think the second finder could be used when using two inch eyepieces, due to weight, but it would be useful from my back yard, when going for a difficult object, like a dim double star out in nowhere.

As a suggestion to the manufacturer, adding a second shoe, the next time a casting mold is made would increase the value of the focuser for intermediate users. I would spread the two shoes out a little more than what the current one is from the center-line to give a little more face room. With a matching pair of shoes, the user could then choose which sides to use for whatever finders are desired, with the user being left or right eyed.

**Further Improvements**

So what is next? I think this scope is a good, light weight travel scope for my trips. There are a few more items I plan on making to optimize it for my personal needs.

The first and easiest is to make a couple of orifice masks with 3.5 and 3.0 inch holes. The 3.5 inch would mimic an Infinity 90 and the 3.0 inch would provide a longer focal ratio at the expense of light gathering power. I found my DS-2102 optical tube to be extremely sharp with a three inch mask in it and think this would also work on the Infinity 102. These would provide some versatility for double star and planetary use. At this point, I cannot even hazard a guess as to which mask would be optimal for that task.

The next is to make a dew shield extension. The existing one extends only 75% of the objective's diameter. I think having one that will extend 150% would work better for my conditions. I need to make sure that the extension does not cut off part of the sky the telescope actually uses, especially for wide angle views. Doing a quick search, I found that a large a round oatmeal box will fit rather nicely inside the existing dew shield, and can be cut off to the right length. I can try that to determine how long to make a more permanent and durable one. What I would really like to have is a dew shield made just like the existing one, but about three inches longer….I think.

Then, build a wooden eyepiece caddy that will fit inside the existing eyepiece tray. I believe I can make one that can handle up to eight eyepieces for cylindrical types like standard four element Plossles, or seven holes and still handle my five 5000 series Plossl eyepieces and a couple Barlows. If I had an accessory tray with no holes in it, I think I could drill six with careful planning and miss the braces below the tray.

Since the finder is as sturdy as it is, I want to find an appropriate spot to mount a small spring-action push-button switch and tie it into the battery circuit. The idea is that when the button is pushed, the red dot lights up. Then, when the button is released, the circuit is cut, saving the battery life. It will then not matter if I forget to turn off the finder after an observing cession is over. If there are buttons like this on any finder, I have not seen them. I think all finders should all have one.

Well, that is all that I have for now. I hope this shows that the rig is good enough for entry level work, even if some of the things I am trying are beyond rational limits.

Thank you for reading my review and I hope you enjoyed it!

Bill Steen