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An Affordable APO: The Orion 80mm ED

2/04 - Tom Trusock - [Click to E-mail Author](#)

The 80ED at a glance	
Manufacturer	Synta (for Orion US)
Size	80mm
Type	Apochromatic Refractor (FPL-53)
Weight	Appx 5lbs 11oz (OTA only)
Focal Length	600mm
Focuser	2" Crayford Type
Length	23.5" with dew shield attached



All images taken by the author except where noted.

The one fundamental truth in astronomy is that aperture is king. No matter who you ask, it's what you hear. Get the largest scope you are willing to handle, because that's what it's all about. Right?

Not quite.

While a larger scope will certainly go deeper, the one thing that folks often forget to consider is that not everyone really needs 10 inches of aperture to enjoy astronomy. Heck, not everyone needs 8 or even 6. It's also been said that the best scope is the one that you use the most, and for a lot of folks – especially ones who are not all that interested in the dim faint fuzzies (which generally just look a little less dim, and a lot more fuzzy until you get to some serious aperture) who are interested in bright targets like planets, Luna, double stars and large bright open clusters. For these folks,



80ED Hots	80ED Nots
True APO class performance	Collimation may be necessary
Portable (especially when coupled when the StellarVue C4 or C5 case)	Room for improvement in mechanicals
High contrast	No sliding dew shield
80mm scope – very portable	Fairly (but not totally) useless mounting block
Cool down is not much of an issue	80mm scope - very small aperture
Good optics	Focuser not lockable
Did I mention it's an APO?	Lens cell not adjustable
	Physically large for the aperture
	Wait times

a small refractor will do quite nicely. A small wide field scope also makes an excellent compliment to those 8, 10 or larger scopes especially if you are looking for something that's quick to deploy and gives acceptable images without excessive cool down times.

If you fall into this category, the choice then becomes achromat or apochromat and is often dictated by your pocketbook.

What's the difference? Well, the technical definition of an achromat is a scope that brings two widely separated colors (wavelengths) of light to focus in the same position, while the technical definition of an apochromat is one that brings three widely separated colors to focus. This means that in an achromat, depending on the focal ratio of the scope, you will see anything from a fine thin green/yellow or purple line on bright targets like the moon, to a rather large purple or green haze. Fast achromats tend to be far worse than slow ones. This "false" color is referred to as longitudinal chromatic aberration.

In *Telescope Optics* by Rutten and Van Venrooij the formula for "acceptable" color performance is given as $FR_{min} = .122D$, where FR_{min} is the *minimum* focal ratio, and D is the diameter in mm. Thus an 80mm achromat would need to have a focal ratio of *at least* 9.76, a 100mm scope of *at least* 12.2 and so on. Be cautioned this is a guideline and not a strict rule. Many observers fondly recall their old 3" (76mm) f15 achromats as giving acceptable levels of false color for lunar and planetary work, so obviously your mileage may vary.

Color is not much of an issue when you are working with low powers and wide fields of view, but becomes one when you start moving to high power views of the moon and planets. Apos make great strides towards eliminating this false color by bringing three colors to focus at the same point and thus effectively reducing or eliminating issues with excessive longitudinal chromatic aberration.

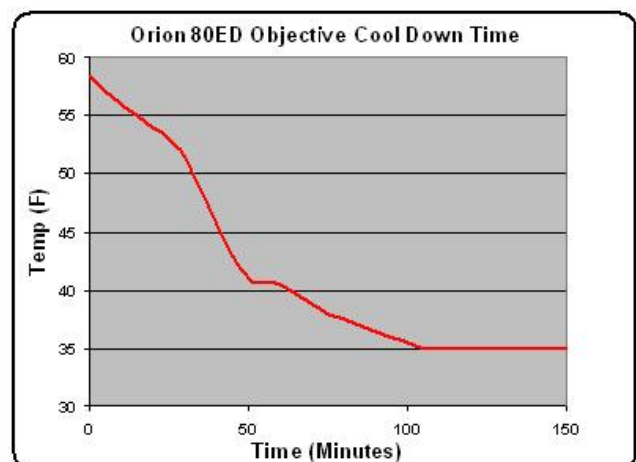
The biggest problem with apos is their cost. Inch per inch they have long been the most expensive

Copyright © 2004 Cloudynights Telescope Reviews scope on the market. Four inches of apo will easily buy you 10 or even 15 inches of premium dob, or 11+ inches of sct. And that's not even considering the mount.



Fit and finish is standard Synta: It's not an heirloom, but the scope will work well for observing...

But look at the advantages apo's have: little to no collimation issues, very quick cool down times, no central obstruction to divert energy away from the airy disk into the diffraction rings, and the capability to yield both wide fields of view and high power in the same instrument. Even if they aren't your primary scope, I'm of the belief that every one needs a "quick look" scope that gives great wide field and planetary views. Apos are perfect for that role. Perfect, perhaps, in everything but price.



Small refractors generally give good views throughout the cool down process.

But even within the category of the apochromatic refractor, there are different designs. Ask a

group of refractor aficionados what they consider "The Best", and you'll get multiple answers. Some like the flat well corrected fields found in petzvals like the TV NP101. Some prefer the minimal air to glass surfaces found in an oil spaced triplet like the AP Traveler offers. Amateurs looking for a bargain in an apo often find a doublet - either fluorite like the Vixen 102FL or ED like the TV 102 - provides the best value. But even a bargain in a 3 inch apo usually runs \$1200 to \$2000 brand new.



Ahh - the subject of much debate - the Chinese ED Apo

That's why Orion's new 80ED is creating such a stir in the astronomy community. With the 80ED reviews/threads being some of the most active pages on the cloudynights.com server, it does not take an optical scientist to figure out this scope is a hot product. Seems like everybody's talking about it. If you don't want one, you're probably speculating on what it's going to do to the high end refractor world - (some folks trade in apos like others trade in stocks). In any event, it's nearly impossible to go into a group and not see some mention of this scope. And with justification - this 80mm (3.15 inch) 600mm f7.5 ED doublet is indeed breaking new ground for its price point. At a cost of \$499 for the ota, it's 1/2 to 1/4 the cost of other comparable apos on the market. Indeed, it's similar in cost to many of the decent *achromats* on the market.

Manufactured by Synta, many folks were (and remain) somewhat skeptical of its status as a true apo in regards to color correction, let alone the overall figure of the optics and the quality of construction. I know. I was one. Initial reports sounded good. Almost too good. Some believed that the first few scopes weren't indicative of what the quality would be when they started shipping in volume. I'd even heard rumors that the Chinese were paying special attention to these early scopes and hand correcting each one. Being in the market for a small scope myself, I was paying the 80ED a fair amount of attention, but honestly thought I'd be spending my money elsewhere.

Then in September of 2003, at the Great Lakes StarGaze, I had a chance to use an 80ED. A vendor had acquired one and brought it as a demo - and despite several offers later in the weekend, flatly refused to sell it. He'd also brought a TV76 and mounted the two side by side on Orion's Atlas mount (just a little overkill for scopes this size, but hey - it was *stable*). When a number of us expressed interest in taking a daytime look, he was quick to respond. The target was the chrome bumper and Chevy emblem on a truck a hundred plus yards off. I think it's safe to say we were all impressed and a little surprised at the extremely small amount of chromatic aberration present in the image, and I (along with several others) added this 80mm scope to the list of ones I wanted to spend more time with that evening. Predictably, after the sun went down, lines developed to view Mars and Vega through the 80ED / TV76 combo. We all came away with one impression - optically, there just wasn't much difference between the two scopes - not much at all.

I went home to chew it over, and a month later placed an order. Less than a week later the first 80ED arrived.

Mechanics

The fit and finish are typical Synta. Nowhere near the quality of a premium apo, but serviceable, and decently done. The backlash

free focuser is a big improvement over low end rack and pinion focusers, and contains none of the glue - err... *grease* that Synta rack and pinions feature. In fact, while lacking the solid feel of the TeleVue focusers, the 80ED's crayford focuser boasts extremely smooth and buttery action, and for pure visual use it bests any pure rack and pinion I've ever used. While it's not possible to truly lock the focuser, the tension is adjustable via a knob on the bottom - quite handy if you have problems with heavy eyepieces slipping. Reports from astrophotographically inclined friends indicate some issues with focuser lockdown when hanging heavy equipment off the back, but I found no problems at the default tension when using it visually with a 2" diagonal and a heavy eyepiece or binoviewer. If you do have problems, there are two 1.5mm hex head allen screws used to adjust the default focuser tension located to either side of the silver thumbscrew.



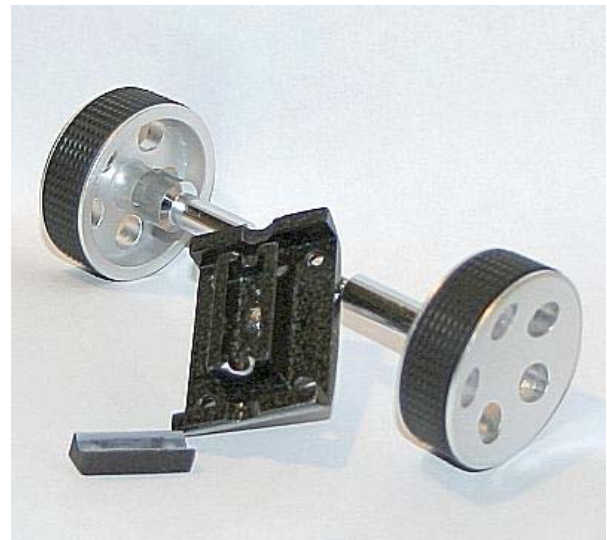
This focuser should be standard on all Synta scopes

One of the units I examined had a slight squeak when focusing and when I disassembled the focuser, I could easily see why. Synta's version of a bearing surface is (at least in this case) metal on metal, and what's worse, the angles where the metals meet are nowhere near similar angles. On many scopes this may not matter, but if the focuser rod hits the braces, the result is a vibration or squeak. I'd guess that as the scope

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is used this squeak would go away as the paint and metal wear into a somewhat better matched bearing surface, but there is a very easy solution and no need to wait.

Simply apply a Dremel or file to the brace to better match the tapered angler of the focuser rod. Be careful not to take too much off, and this procedure will eliminate your squeaks entirely.

Warning - this, along with other modifications described in this article will probably invalidate your warranty, so proceed at your own risk.

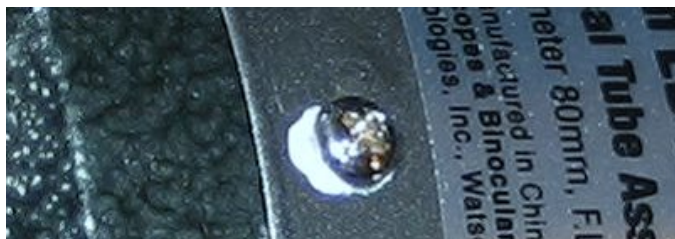


Dremel was here

The OTA itself is mechanically decent but there are a few things that could be improved. Currently there are no provisions for adjustment of the lens in it's cell. This is a bit annoying as these scopes have shown themselves to posses excellent optics, but most arrive slightly out of collimation - as did the first sample I had a chance to examine in-depth. Fortunately, there is a fairly easy (abet not exacting) fix. While there are no provisions for adjusting the lens itself, you can adjust the focuser to ensure that it's pointed at the center of the lens. The easiest way to do this is to point the OTA down, insert a laser collimator into the drawtube and see where it hits the lens. If the laser does not hit the center of the lens loosen the screws that hold the focuser to the OTA, adjust the position of the focuser and repeat the check. This usually results in an acceptable alignment. It may be necessary to

enlarge the holes slightly using a file or Dremel - be very careful so as to not over enlarge the hole when doing so.

Another thing that seems to be an issue with some shipments: the focuser is evidently slightly smaller than the ota and when the screws which attach the focuser to the tube are tightened, the tube flexes and the paint chips around the screws. Out of the three units I've seen, only one suffered from this. Fortunately this is purely cosmetic, and a minor issue. Unfortunately at this point I'm completely unaware of an automotive (or other) touch up paint that matches the scopes gun metal grey. Ironically, of the two samples I've had extensive experience with, the only sample with to show this type of chipping was the one that arrived in collimation. I suspect this is because it had been collimated while at Company 7 - something they advertise on their web site - and the focuser had been tightened to maintain it's position. (The other sample was ordered direct from Orion through a local hobby shop.)



A close up of the infamous paint chips

In overall size the 80ED is something of a misfit - it's an 80mm lens in a Synta 100mm f6 body. While this saved Synta some money that they can (presumably) pass on to the end users, the down side is that the scope is fairly large for it's actual aperture. However with the dew shield removed, it still easily fits into an airline approved carry on case.

Most people considering this scope are willing to deal with these small issues. Unfortunately these seem to be part and parcel with most Chinese manufactured scopes.

If you purchase one of these as an ota, be advised you will need to provide a mount, a diagonal and any other accessories you may need or desire. (Hand holding tends not to be very effective at 200x). While the mounting block does provide a 1 ¼ - 20 threaded hole, don't count on mounting this one on a tripod. The 80ED is just too large for this except at the lowest possible powers. You can use the mounting block to attach the scope to a Gibraltar style mount - but be prepared for balance problems. With the addition of the Pronto Balance Plate the scope behaves a little better and is quite functional but balance is still off when switching eyepieces and there is no easy way to adjust it. A better solution might be to purchase a set of tube rings and mount it conventionally. I understand that the TV 4" tube ring works, and standard rings are available from many different sources.



Stock visual back on the left, Mercury Systems compression ring on the right

If you would like to replace your thumbscrew based visual back with a compression ring version, Mercury Systems manufactures just the thing: their SFA2 replaces the stock visual back and runs around \$32.

You will also need a diagonal - preferably a good two inch unit. The Williams Optics 2" is a compression ring unit which retails for around \$100, gives you 97% reflectivity and includes a low profile 1.25 to 2" adapter. This has to be one of the best deals around today and it's a great match for the Orion 80ED.



As others have remarked, the Williams Optics 2" Diagonal is a perfect match

And finally don't forget the finder. In light of the fact that this scope provides a 4.4 degree TFOV when paired with the appropriate eyepiece - in effect becoming it's own finder scope - you will probably want to opt for a unit finder. Orion's own EZ Finder is an excellent choice but there are many out there that will work well.

Optics

But, ("Get to the point Trussock!") on to the meat. The real question is: how are the optics?

Orion advertises the lens as being fully multi-coated, and looking down the throat of the ota I can tell you from certain angles the lens nearly disappears. The coatings are, in a word, excellent. This bodes well for canceling internal reflections and keeping transmission as high as possible. The OTA has 2 knife edge baffles which work well to ensure a high level of contrast.

In use the 80ED passed the snap test with flying colors. Even though it's a moderately long focal ratio, the image definitely had a clean snap to best focus. Poor optics will have a range of focus where one spot is much the same as another - the 80 showed none of that.

To the right, you can see the ronchi pictures tell part of the optical story – surprisingly good optics for a mass produced scope. (Note: a star test is more sensitive than the ronchi test, and aberrations tend to show more easily there.)

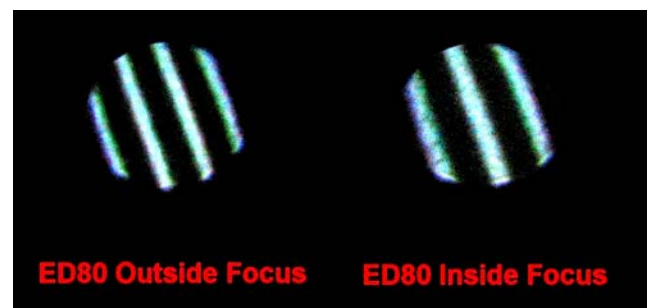
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It was interesting to note that both of the samples I've had extended access to have tested similarly (after the initial focuser alignment necessary on one unit). There was no sign of pinched optics in either and only small amounts of spherical aberration.

Note: when star testing a doublet refractor such as the 80ED, it's important to realize that the intra and extra focal patterns will look slightly different than one sees in most books and images - the reason for this is simple - in an ED doublet such as this, the out of focus images tend to show false color and this can interfere with the appearance of the diffraction patterns in such a way as to resemble spherical aberration.

Taking this into account, star tests showed the rings to be well defined and concentric, showing no sign of rough surfaces or zonal aberrations, but with a small amount of under correction (one was slightly worse than the other) and a slight but negligible miscollimation remaining. Neither 80 showed signs of astigmatism. Overall, the optics (at least in these early samples) are surprisingly good, and compare well to scopes that cost several times more.

The views have been simply wonderful for such a small scope. Extremely contrasty, high in resolution - optically, it's done everything I've asked and then some.



Color Correction

The color correction is excellent, far better than an achro of comparable size and focal length, and as good or better than several competitors ED scopes costing far more. Orion has confirmed that Synta is using the equivalent of

FPL-53 - this is one of the same types of glass AP uses. It shows. False color is about what you would expect from a good ED/Fluorite doublet - the 80 shows only a minor amount of in focus chromatic aberration, and only on the brightest targets.



Full frame shot (resized)

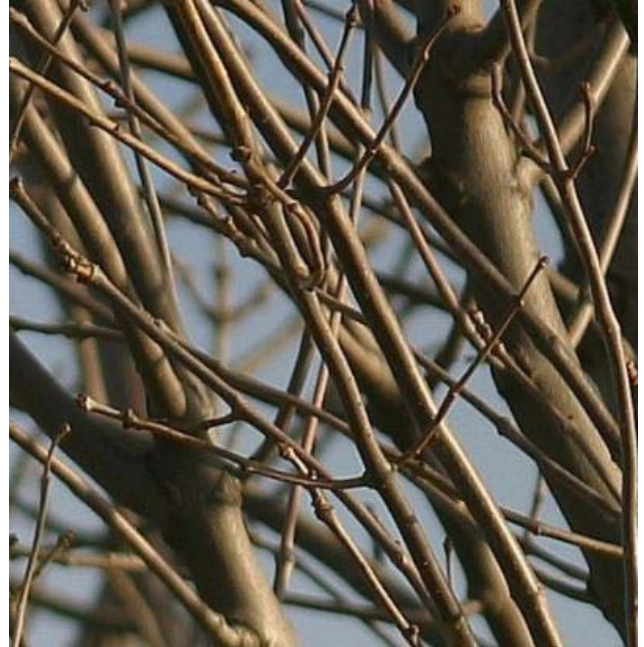
These pictures were taken with my Canon EOS-D60 (6.3 mp digital SLR) in broad daylight to help show the amount of longitudinal chromatic aberration inherent in the lens. Shots like this typically show far more error than you will see by eye, and are to be considered a fairly extreme test.

In visual use, extended side by side comparisons with a Televue 102 and Genesis SDF showed the images to be quite comparable. Obviously the 4" scopes revealed more detail and reached deeper, but otherwise views were surprisingly similar. In focus false color was certainly in the same ballpark for all three. If pressed, I'd say the SDF showed the most, but I wouldn't even care to venture a guess between the 80 and the 102. All three were very close. While this is not a strictly accurate comparison, it should serve to give you something of a baseline as to what to expect.

The views have been everything you would want from a small apo. Lunar landscapes are detailed and contrasty; shadows show pitch black, and low contrast features stand out as well as you could ask for in any scope regardless of price. Diving for Platolets, I was able to come up with the big four fairly easily. And although I wasn't

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able to pick out the rille in the Alpine Valley, I was able to pick up several other low contrast rills and domes.

Mars and Saturn are very pleasing in the 80ED. Saturn in particular showed multiple bands, the Cassini division, the shadow of the globe on the rings, and the 80 even offered a glimpse of the shadowy Crepe ring as it crossed in front of the planet.



Full scale cropped selection from above image (full size)

The 80ED took high power with aplomb as well, as images held up very well to the traditional 60x per inch and a bit beyond. I tended to run out of light before the image seriously broke down.



M33 w/ 80ED and ST-8
Photographer: Joe Bruessow

It split doubles and multiples well, showing - at extremely low powers - four stars in the Trapezium and cleanly splitting the double double at a mere 66x (9mm ortho). This is excellent performance for a small scope. Dropping back to the 13mm Nagler (46x) turned out to asking a bit too much, and I wasn't the least bit surprised that I couldn't make the split. However I've heard of one 80ED owner who managed it at 55x, and I have to say I'm not at all surprised.



Prime Focus - 80ED and Canon D60

On deep sky the 80 performs as well as it's aperture allows. With a 30mm 80 deg AFOV eyepiece, it provides a 4+ deg TFOV - and is stunning for targets like the Pleiades and the Andromeda galaxy. With a 24 Panoptic, the TFOV is nearly enough to enclose Orion's belt, and both the 24 Panoptic and 13mm Naglers gave excellent views of M42. Late one evening, under a nearly full moon, I surprised myself by pulling out M78 - a nebula that I've never found imposing under small apertures even in dark skies. Wide bright doubles like Albireo are jaw droppingly beautiful. I spent the better part of enjoying M35/NGC2158 and the chain of M37, M36, and the M38/NGC1907 combo. The Ring (M57) showed as a ghostly donut, and I found myself spending several enjoyable evenings last fall in Cassiopeia, studying the different NGC/IC

Copyright © 2004 Cloudynights Telescope Reviews and Messier clusters. Without a doubt, the real show stopper, and one of my all time favorites, had to be the double cluster. Small refractors excel at open clusters.

When coupled with an appropriate case (I suggest the StellarVue C4 (hardcase) or C5 (softcase) – as of this writing, the foam for the C4 case fits perfectly, while the C5 foam will require a little cutting), and a 112mm plastic cap to cover the lens when the dew shield is removed (Available from B&H Photo - item SCLC112), the 80ED travels quite well - even meeting regulations for airline carry on. It's just the right size to toss in the back of a packed car when heading out on a family trip, and came in quite handy for this fall's lunar eclipse when I found myself in the city. Fighting the temperatures, my parents and their neighbors came out to stand in the cold and watch the eclipse - both naked eye and through the 80ED. Even my 2 year old daughter was captivated by the views through the scope, clearly recognizing what she saw and extremely reluctant to move away from the scope.



For travel couple the ED80 with the C4 case...

Conclusion

The question has come up many times: How can Synta afford to manufacture and sell this scope

for the price they do? Especially since an ED blank in the states seems to cost a significant fraction of the entire cost of the 80ED. Well, I have it on good authority that they are manufacturing their own glass instead of purchasing it from any of the typical suppliers, and remember, wages in China don't match wages in the US.

As of this writing, (December 03 / January 04) Synta has been shipping in small lots - 30 - 40 scopes per, and also as of this writing, there have only been 3-4 lots delivered to the US. Demand is high. As a result you can find yourself in a bit of a wait for this little scope.

So how does it stack up to a heirloom quality apo like an FS78 or TV76/85? Well – that's a complicated question, and it's answer depends largely on your outlook on the hobby.

It seems there are astronomers who desire only to gaze upon the night sky, and astronomers who love to own fine things. And then there are ones who fall in the middle and want both. In my opinion (and my heart), there will always be a place for companies that produce telescopes with the level of craftsmanship of TV, Tak, AP and the like. The 80ED is a telescope for someone who wants top notch apo optical performance but for one reason or another does not want to pay

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for the build quality and craftsmanship found in the mechanicals of the premium apos.

If I was offered a TV76 for an 80ED, would I do it? Of course! I don't think anyone would do otherwise. However, that's not really the issue. Only you can decide where your price/performance point lies. Personally, I know there will always be a place for a finely crafted apochromat in my heart, but there's more room in my wallet for a less finely crafted scope as long as it has excellent optics. While this scope won't put the premium manufacturers out of business, it will probably introduce many amateurs to the apochromat concept who never previously considered one.

Overall, the 80ED is an interesting mix that will appeal to the amateur looking for a bargain apo. While it's mechanicals leave significant room for improvement, the optics stack up well in comparison to some of the finer apochromatic refractors on the market. Ideally, it would be nice to see some enterprising company source the 80ED lens and place it in a truly first class ota with adjustable cell, retracting dew shield, and high quality focuser. If such a scope could be brought to market for a reasonable price (say around \$850), demand would be fantastic.

I suspect this scope will do extremely well, and with good reason.

Further reading

For more on color correction, lens design and general information on apos and achros try the following:

- Jay Reynolds Freeman - [An Introduction To Chromatic Aberration In Refractors](#)
- Roland Christen - [More on Color Correction](#)
- Roger Ceragioli - [A Survey of Refractive Systems for Astronomical Telescopes](#)

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Tom's been irrationally attracted to small refractors since owning his first TeleVue Ranger many moons ago.