

REVIEWED

SHARPSTAR 76EDPH REFRACTOR AND F/4.5 (0.8x) FULL-FRAME REDUCER



▲ The three-kilogram SharpStar 76EDPH optical tube and mounting hardware equipment for visual use, on a Sky-Watcher Star Adventurer mount and balanced with a one-kilogram counterweight on a double-length shaft. All images: Ade Ashford.

The sharp end of telescope progress

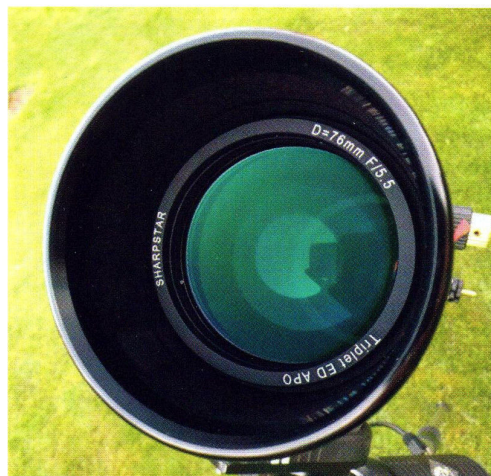
Ade Ashford reminisces while evaluating a versatile 76mm, f/5.5 photo-visual refractor and reducer-flattener.

At a glance: SharpStar 76EDPH

Optical design:	Air-spaced triplet apochromat with ED glass element
Coating:	Multi-layer coating on all lens surfaces
Aperture:	76mm
Focal length:	418mm
Focal ratio:	f/5.5
Resolution:	1.5 arcseconds
Length:	330mm (with retracted dewshield)
Tube weight:	2.3kg
Total weight:	2.9kg (including tube rings and dovetail plate)
Tube diameter:	90mm (dewshield, 100mm)
Focuser:	2.5-inch rack-and-pinion focuser with 1:10 reduction gearing
Drawtube travel:	60mm
Price:	£879 (£792 with 365Astronomy's 10 per cent introductory promotion)
UK supplier:	365astronomy.com
Manufacturer:	sharpstar-optics.com

At a glance: SharpStar f/4.5 full-frame reducer for 76EDPH:

Effective focal ratio:	f/4.54 (measured, 0.825x reduction)
Effective focal length:	345mm (measured)
Image circle:	44mm (full-frame)
Optical design:	Triplet
Coating:	Multi-layer coating on all lens surfaces
Diameter:	88mm (66mm without collar)
Connection to telescope:	M74x1 thread
Connection to camera:	M48x0.75 thread
Back focus:	55mm (optimal for DSLR)
Rotation for framing:	360-degrees
Length:	77mm (including M48 thread for camera adaptor)
Weight:	0.5kg
Price:	£259
UK supplier:	365astronomy.com
Manufacturer:	sharpstar-optics.com



◀ Far left: The 76EDPH's dedicated reducer-flattener is a triplet design with an unspecified ED-glass element with the same very effective multi-coatings used on the objective. There is a thin 88mm diameter collar that prevents the reducer from screwing too far into the drawtube. The M48 camera interface can also accommodate an internal two-inch filter and the entire camera end rotates through 360 degrees, for composing a shot.

◀ Left: Although SharpStar does not publish specifications of the ED-glass element used in the 76EDPH's 76mm, f/5.5 air-spaced triplet objective, extensive field testing revealed an exemplary optical performance.

When I first started taking a keen interest in optics 45 years ago, most dedicated observers heeded Patrick Moore's advice and aspired to own a 'large' 76mm (three-inch) aperture refracting telescope. Such instruments typically possessed tubes a dozen times as long as the diameter of their front lenses, which I felt made them rather ungainly, particularly with the tall tripods that would be required when one wished to look at objects overhead. What my 12-year-old self didn't appreciate at the time, of course, was that simple achromats needed to be so long in order to suppress the false prismatic colours of chromatic aberration when observing bright objects. So when I first set eyes on the SharpStar 76EDPH, an instrument one-third of the length of those classic refractors of yesteryear and effectively superior to them in virtually every respect, I couldn't help but reflect on just how far optical design and materials have advanced since the 1970s.

For the past few decades of observing, my personal preference has been for the squat tubes and versatility afforded by catadioptrics such as Schmidt- and Maksutov-Cassegrains or Schmidt- and Maksutov-Newtonians. Yet, in the years of the present millennium, in tandem with a growing interest in photography, I've followed the evolution of premium refractors. Their unobstructed apertures, peerless levels of contrast, versatility, thermal stability and robustness have much to recommend them. Spurred on by advances in new extra-low-dispersion ('ED') glass types by companies such as Astro-Physics and Takahashi, other, largely East-Asian, manufacturers have forged ahead with innovative and highly corrected refractors at very competitive prices. As new types of ED glass appear and lens geometries evolve, refractors are getting ever shorter, since acceptable levels of colour correction are now attainable at focal ratios of f/4 or smaller.

Who are SharpStar?

Jiaxing Ruixing Optical Instrument Co., Ltd, trading as SharpStar Optics, is located in Zhejiang Province, near Shanghai on China's central coast. Keen *Astronomy Now* readers will recall our review of SharpStar's 150mm, f/2.8 hyperbolic Newtonian astrograph in the December 2019 issue, but you will have encountered their products before under a number of different brands. The company has been trading for 20 years and is an original equipment manufacturer (OEM) of high-end astronomical telescopes for companies such as Telescope Service (TS-Optics) in Germany, TecnoSky in Italy and Astro-Tech in the USA for more than a decade.

Delivery and first impressions

A SharpStar-brand telescope always delivers a memorable first impression. Their striking scarlet

▼ The review 76EDPH's triplet objective was perfectly collimated without any trace of astigmatism. Each of objective's three glass elements is independently adjustable in the cell via minute grub screws.

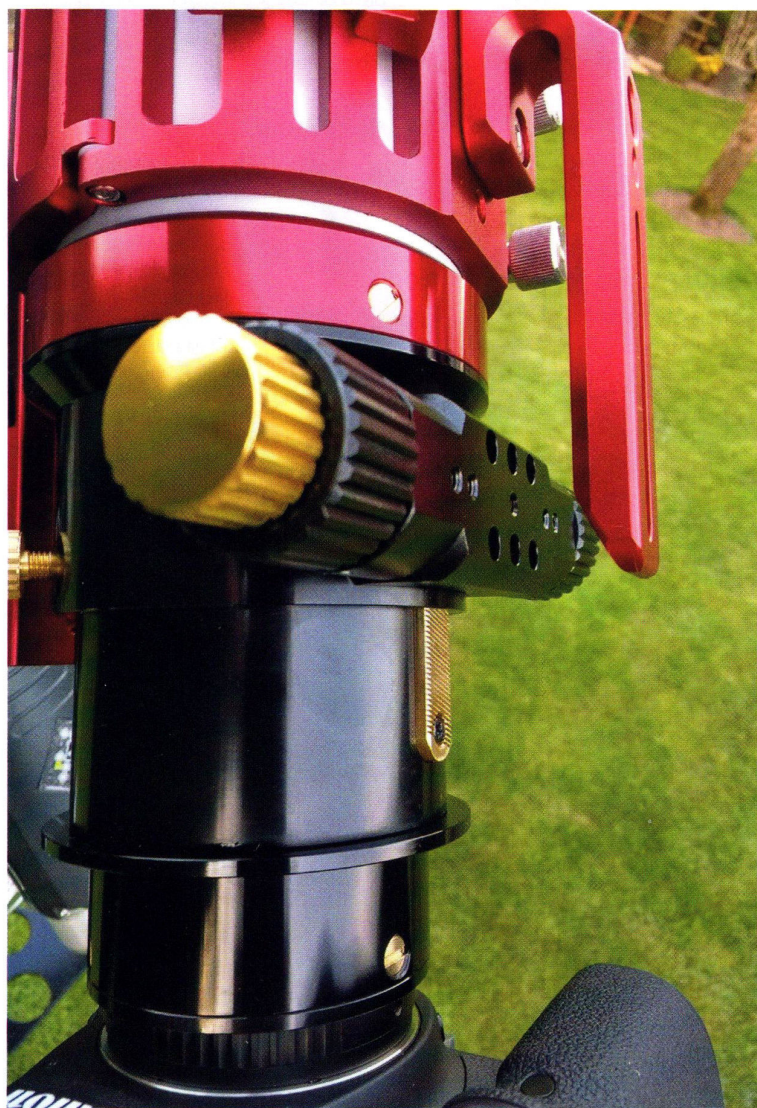


This is undoubtedly a focuser that can also handle a lot of weight with ease

CNC fixtures and fittings contrast strongly with the white tubes and hard gloss, black anodised focusers and drawtubes, a livery that immediately sets them apart from competing OEMs and exudes an undeniable air of quality. Supplied in one double-skinned cardboard shipping box with foam inserts, the 76EDPH's 90mm diameter tube measures just 330mm from the front of the retracted 100mm-diameter dew shield to the rear of its 1.25-inch push-fit eyepiece adaptor, with the 63.5mm (2.5-inch) diameter rack-and-pinion focuser fully wound in. The mass of the optical tube is a surprisingly light 2.3 kilograms and remains under three kilograms even with the mounting hardware attached.

The SharpStar 76EDPH abandons conventional tube rings in favour of an 11-centimetre-diameter

▼ The review instrument's rack-and-pinion focuser with 1:10 reduction gearing was extremely smooth and responsive over its 6cm range, with no backlash whatsoever.



and eight-centimetre-long cylindrical alloy 'cage' with CNC-machined weight-saving cut-outs. The cage is hinged in half, and the optical tube is clamped securely by two knurled silver thumbscrews. The upper half of the cage sports an 11-centimetre-long multifunction carry handle with a machined central six-centimetre-long channel that can double as a DSLR piggyback camera bracket, plus there is a standard dovetail shoe for a finder or guidescope. The underside of the cage is attached to a 15-centimetre-long adjustable Vixen-style dovetail rail for attaching the 76EDPH to a wide range of compatible mounts. The dovetail also sports a central 1/4-inch-20 thread for mounting it on a robust photo tripod for daytime terrestrial use, or the dovetail L-bracket of a Star Adventurer Pro mount – more on this later.

The review instrument's rack-and-pinion focuser, with 1:10 reduction gearing, was extremely smooth and responsive over its six-centimetre range with no backlash whatsoever, but a little on the stiff side for my liking. That said, every aspect of the focuser is adjustable for those who feel the need, but tolerances are usually tight when an instrument is new, and often improve once the pinion and brass helical rack bed-in. This is undoubtedly a focuser that can also handle a lot of weight with ease. The entire rear of the instrument is rotatable through 360 degree and has a brass thumbscrew to lock it in position. The 63.5mm (2.5-inch) diameter rack-and-pinion focuser has ample travel for the vast majority of 50.8mm (two-inch) and 31.75mm (1.25-inch) oculars in star diagonals of either format – everything in my collection came to focus without issue.

The two-inch push-fit adaptor has a copper compression ring to protect your optical accessories secured by three knurled thumbscrews at 120-degree intervals, reminiscent of a capstan. The supplied 1.25-inch eyepiece adaptor also has a copper compression grip to prevent marring of ocular barrels. The focuser's drawtube sports a millimetre-graduated scale for reproducing approximate visual and photographic foci. I noted a four centimetre drawtube extension for visual use with a 1.25-inch star diagonal and a typical eyepiece, which is almost exactly parfocal with the f/4.5 focal reducer-flattener (again, more on this later) when used with a DSLR – it may be a small detail, but it's typical of the 76EDPH's good yet subtle design elements.

Optical quality for visual use

The 76EDPH acquitted itself impressively during extensive field testing in March 2020. At the low-power end of the magnification range, a fully dilated pupil of 5mm implies that adults

shouldn't use this telescope with magnifications of less than about 15 $\times$ to ensure that all of the precious light from the 76mm aperture is accommodated by the eye. Hence eyepiece focal lengths longer than about 28mm should be avoided, but with wide- and flat-field oculars it's possible to experience stunningly crisp vistas in excess of five degrees. Low-magnification views of open star clusters with the 76EDPH fully exhibit the 'diamond dust on velvet' effect, with faithfully rendered star colours.

For critical high-power testing, I used a 3.2mm TMB Optical Planetary II eyepiece, delivering a magnification slightly in excess of 130 $\times$. The quality and correction of the 76mm, f/5.5 triplet objective is easily capable of handling powers far greater than this, but herein lies the problem with compact refractors: unless one is prepared to use a premium ED Barlow lens, quality oculars with focal lengths less than 3mm are required. However, out of a desire to use an eyepiece of known performance without the potential introduction of aberrations from an intermediate optical accessory, I stuck with the 3.2mm TMB. Furthermore, the 0.58mm exit pupil didn't exacerbate floaters and associated diffraction effects in my eyes.

On a night of moderate-to-good seeing, long after the instrument had acclimatised to the ambient temperature, it was immediately apparent that the 76EDPH's triplet objective was perfectly collimated without any trace of astigmatism. (Incidentally, each of the objective's three glass elements are independently adjustable in the cell via minute grub screws, although you should leave such adjustments to an optician – not that it should ever need it in a lifetime of normal handling.) Use of a green filter in addition to a Ronchi grating revealed intra- and extra-focal star images with a level of correction and surface smoothness that even some manufacturers of über-expensive bespoke refractors would be happy to attach a QC-pass sticker to.

The interior of the tube uses a combination of flocking and machined baffles in the drawtube to deliver superior suppression of stray light. Given that the 76EDPH is so good, I decided to employ a test that I would not normally subject a refractor to, since it is almost cruelly harsh: Venus close to maximum brilliancy. Viewed unfiltered as astronomical twilight faded to dark on the evening of 22 March, Venus' 23-arcsecond-wide, 52 per cent-illuminated and magnitude -4.3 disc didn't show any scattered light in the field of view – which is testament to the effective lens multi-coatings and internal light sealing – nor was there any false prismatic colour other than a miniscule and subtle yellowish-green hue.



▲ Converting the 76EDPH from visual to 'astrographic' mode with the f/4.5 full-frame reducer–flattener entails unscrewing the drawtube's visual back, exposing a female M74 $\times$ 1 thread, then screwing the nosepiece of the 77mm-long reducer in its place.

▼ The SharpStar 76EDPH plus f/4.5 reducer–flattener with a Canon 6D camera attached.



Astrophotographic potential

Converting the 76EDPH from visual to 'astrographic' mode with the optional dedicated f/4.5, full-frame reducer-flattener, entails first unscrewing the visual back from the drawtube, exposing a female M74x1 thread. You can then simply screw the nosepiece of the 77mm-long reducer in its place. Before doing so, I took stock of what an impressively made unit the reducer is. Finely machined and with a glossy, hard anodised finish, the reducer tips the scales at 500 grams. When not in use, there are beautiful turned-metal dust caps, also hard anodised, that screw on either end.

The 76EDPH's dedicated reducer-flattener is a triplet design with an unspecified ED glass element that has the same very effective multi-coatings as used on the objective. There is a thin, 88mm-diameter collar that prevents the reducer from screwing too far into the drawtube. On the camera end there is a standard M48x0.75 thread, so that all my Canon 6D needed was an M48-to-EOS adaptor and the conditions for a 55mm back focus are automatically satisfied. The M48 camera interface can also accommodate an internal two-inch filter and the entire camera end rotates through 360 degrees, for composing a shot.

It so happened that the dark of the Moon that I had set aside for exhaustive astrophotographic tests coincided with a lockdown owing to belonging to an 'at risk' group for the novel coronavirus, so I was frustratingly denied my usual test equipment and locale. However, necessity is the mother of invention, and I was able to use the maxed-out 76EDPH with a humble Sky-Watcher Star Adventurer Pro on a sturdy Manfrotto 055 photo tripod. Having acquired a spare Star Adventurer counterweight shaft, I discovered that it's easy to join the two together with a short length of M6 threaded rod. Thus I was able to mount the four-kilogram weight of the telescope, reducer, Canon 6D and a guidescope on the Star Adventurer's dovetail L-bracket, and balance it all with a single one-kilogram counterweight, while keeping inside the payload limits of the little mount.

Image analysis

My full-frame Canon 6D DSLR has 6.54-micron pixels. Plate-solving images captured with the StarSharp 76EDPH, f/4.5 reducer-flattener and 6D yielded a true focal length of 345mm, hence the actual focal ratio of the review instrument was f/4.54, which is still impressively fast. For example, compared to my six-year-old TS APO65Q flat-field refractor at f/6.5 (which, incidentally, is also an early SharpStar-manufactured instrument), the reviewed 76EDPH combo needs an exposure less than half as long as the 65Q to record the same extended

The 76EDPH acquitted itself impressively during extensive field testing

object, such as a nebula, with all other factors being equal. The software *CCD Inspector* reveals that the 76EDPH at f/4.54 has a field curvature of about 20 per cent across a 36mm x 24mm full-frame and, without a clip filter, a vignetting of just four per cent at the corners of the sensor. Star images are round to the corners too.

Final thoughts

It will be interesting to see, in a post-COVID-19 world, whether East-Asian manufacturers of premium optical instruments, such as SharpStar, will still be able to produce such undoubtedly impressive instruments as the 76EDPH at the very competitive prices that we have become accustomed to. I strongly suspect that the price of such equipment will rise substantially. Regardless of whether or not the 76EDPH's triplet objective and reducer-flattener use ED elements of FPL-53, or a Chinese-made glass called H-FK95N that has similar optical properties, SharpStar should be congratulated on a finely executed design. It is an extremely well-conceived marriage of glass types, anti-reflection coatings and lens geometry, all resulting in a fast objective with a remarkably high level of colour correction for its price point.

Ade Ashford has travelled the globe writing about astronomy and telescopes, serving on the staff of astronomy magazines on both sides of the Atlantic. His first *Astronomy Now* review appeared a quarter of a century ago.

▼ The SharpStar 76EDPH's 63.5mm diameter rack-and-pinion focuser has 60mm of travel to accommodate the vast majority of two-inch and 1.25-inch oculars in star diagonals of either format.

