Hotech SCA Field Flattener

A Non-reducing Field Flattener that Works!

By Alan Smallbone

We are lucky enough to live in times when affordable refractors can be had for a reasonable price. This has made travel and wide-field imaging telescopes widely available and at reasonable cost. One of the things that are often missing with some of these refractors, however, is a suitable field flattener. Many manufacturers make fine reducers – some work better than others – but very few make flatteners.

Many imagers like flatteners that do not also function as reducer so they can get a little bit of extra focal length, but most of those that are available are designed for a specific refractor and not for general use with other models. After doing some searches online, I found only two general-purpose flatteners; this review is of one of them, the Hotech SCA Field Flattener.

The SCA Field Flattener is designed for refractors ranging from f/5 to f/8, which will accommodate most of the common refractors on the market today. The Hotech flattener attaches to the scope via a 2-inch drawtube. The camera connection is a standard T-thread interface.

What makes this device unique is the "SCA" feature; it is the Self-Centering Adapter that Hotech has cleverly designed to counter the "slop" that would otherwise occur between the flattener and the drawtube into which it is inserted. The user inserts the adapter into the drawtube and then turns a ring that causes expansion bands on the adapter to expand out and center the device in the drawtube. More information and pictures of the device can be found on the Hotech USA website, www.hotechusa.com.

The SCA was unique enough that it was patented, and now it seems there are other manufacturers out there attempting to duplicate the design and hoping to jump on the self-centering bandwagon – just something to keep in mind when you see ads for this kind of centering feature from other sources.

I was at first a bit skeptical of the flattener, given the many optical devices that do not live up to expectations, but after a few email messages to David Ho, its designer, I decided to give it a try and ordered one. I was concerned about just how flat the field really was and whether the flattener would work with the specific combination of my scope and camera. But, I was pleasantly surprised by the build quality of the flattener when I received it, and was impressed with its overall design and fit and finish – so far, so good!

Focuser drawtubes were originally designed to simply hold eyepieces and to allow for them to be changed quickly; they were not specifically developed with imaging in mind. Therefore, many manufacturers did not hold to close tolerances and whatever is inserted in the focus drawtube is simply held in place by one or two setscrews, which is fine for viewing and generally gives a secure enough hold for eyepieces used for visual work.

However, when imaging, all of this changes. Any misalignment or tilt of the accessory inserted into the focus drawtube can cause aberrations in the image, and the average camera assembly weighs far more than even a

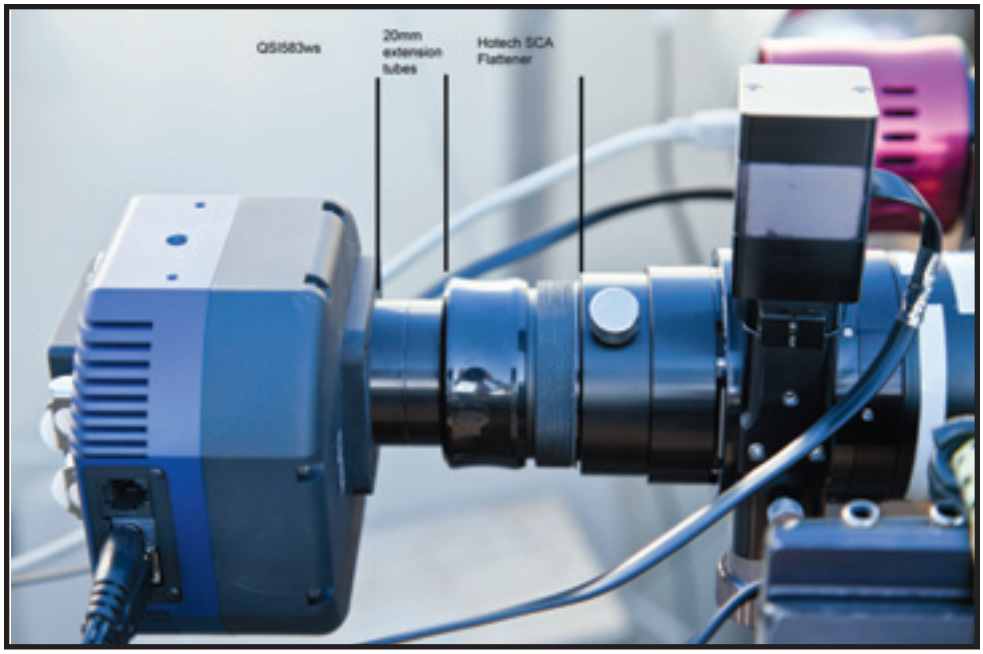

Image 1: The Hotech SCA Field Flattener is attached to a Borg 125SD equipped with a Feather Touch focuser and supports a QSI583ws camera via two 10-mm spacers.

large eyepiece, so more secure and reliable attachment is needed. Because of these concerns, I usually prefer to use threaded adapters to attach cameras to a scope as this helps to eliminate flex, especially when using the 2-inch drawtube.

When testing the Hotech SCA Field Flattener, I attached a 2-inch drawtube to the back of my Borg 125SD's Feather Touch focuser and inserted the flattener with its adaptor. I was pleasantly surprised at how well and easily the adaptor centered the device in the drawtube and also with the security of the attachment. With the adapter, tightening the thumbscrews on the drawtube did not cause any tilt or misalignment. **Image 1** shows the SCA Field Flattener attached to the Feather Touch focuser with my Quantum Scientific Imaging QSI583ws camera attached to the flattener. This flattener requires a spacing of 55 mm from the attachment point to the sensor plane, which is a common spacing for DSLRs as well. The QSI583ws has 35 mm of back-focus, so I attached two 10-mm extension tubes to get the necessary additional 20 mm and I was ready to image.

The Borg 125SD is designed at f/6. I have an f/3.9 reducer and an f/5 reducer from Borg; while these are both fine reducers, I really wanted a little more reach and that is why I decided to get this non-reducing flattener. So, after running some *FocusMax* v-curves and getting the focus set, I wanted to see how

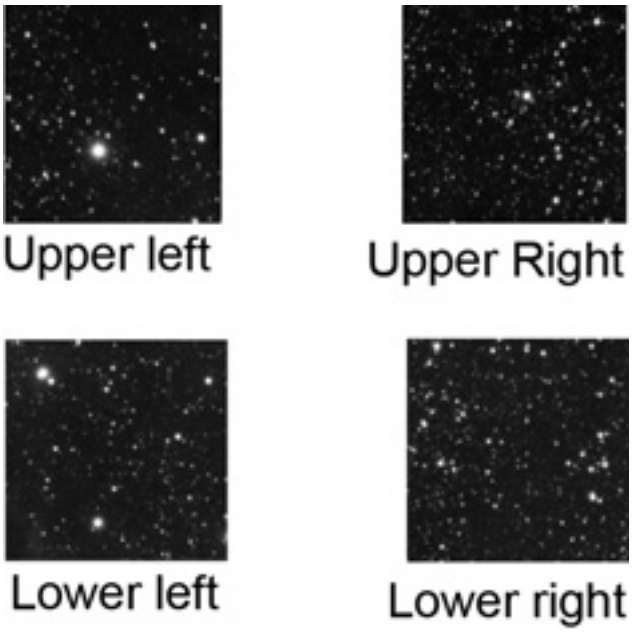

Image 2a: A close-up of four corners of a test image produced using the Hotech flattener.

Image 2b: The entire frame from which the corner images shown in Image 2a were taken.

well it performed.

The first order of business was to determine the actual focal length and see if the flattener had added any reduction or extension from the native focal length. I have seen some flatteners actually magnify the image slightly. I calculated the actual focal length using a plate solve, and found that it came out to 752 mm, within 2 mm of the theoretical focal length. This was promising. The next order of business was to look and see if it provided a truly flat field.

All imagers seek to have perfectly round stars from edge-to-edge across an imaging frame. With the advent of larger sensors, this has become more and more difficult to achieve and can really push the limits of some optical designs. There are many types of aberrations, but most are usually more prominent in the corners of the frame. One is color aberration, which can occur in non-apochromatic scopes; this is commonly evident around stars as fringing – typically blue or purple color rings. There is not a lot an imager can do about this, other than getting well corrected optics or spending a lot of time in post processing.

Another common aberration distorts stars so they look like little comets. This can be caused by guiding errors or mount misalignment, which usually cause streaking across the whole image, but is something that the imager can control with some fine tuning.

Star distortions can also appear in the corners of an image, sometimes just in one or two corners; these are usually caused by tilt – again something the imager can correct with fine tuning.

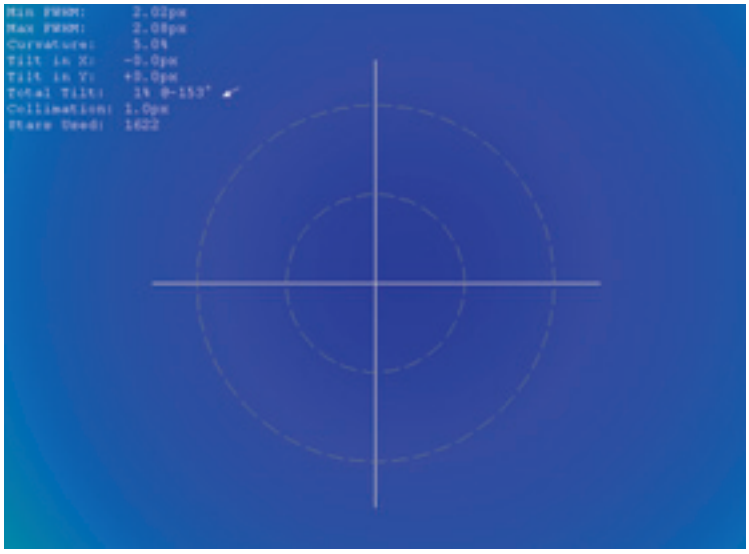

Image 3: Flat-field plot produced by *CCDInspector* using the Hotech flattener.

Still another type of aberration can look like comets radiating toward the center of the image from each corner. This is most commonly caused by not having a "flat field," which means that the image shows field curvature from the optical design. This last is the type of aberration that can be corrected by a competent flattener.

A quick look at the corners of my test image showed that the Hotech flattener yielded a very nice looking "flat image." In other words, the stars were nice and round and not distorted, even in the corners of the image. See **Image 2a** for a close up of the four corners of this image, which is "raw" single frame without any processing. **Image 2b** shows the entire frame. After looking at this I was quite happy and very impressed; so far the flattener had lived up to the claims!

The next test was to do some serious imaging! After taking a night's worth of images, I ran all the frames through a very useful program called *CCDInspector*. This program will analyze frames for flatness and curvature, and has some other useful tools. The plot the program produced says it all; the field was very, very flat all the way across and through all of the images. This flat-field plot is shown in **Image 3**.

This plot was produced from all the images taken on a single night. As you can see by the almost-even solid-blue color, there is not much change in the shape of the stars across the field. The Full Width Half Maximum (commonly referred to as the "FWHM"; it expresses the width of an object that lacks sharp edges) did not vary much across the whole frame. Such results are consistent with a well-corrected, flat field without any obvious signs of distortion. A stack of the images and processed as a final image is shown in **Image 4**.

Well, after this test run I was a very pleased. The flattener lived up to the claims and now I have the ability to image at the native focal length of my Borg 125SD! Overall, I found the Hotech SCA Field Flattener to be a well-made, well-designed unit and I would

recommend it. The coatings on the optics do not add any aberrations, and the flattener provides a very crisp and clear image all the way across the frame of the image.

My only complaint is that Hotech does not currently offer a version of the flattener in a larger diameter. The T-thread interface is a nice one, and certainly very popular, but it will cause some vignetting with a larger-sensor camera, so it would be helpful if a version of the flattener was also available in a larger diameter. Of course, making large-diameter optics is expensive, which is certainly a consideration, but hopefully Hotech will explore this option in the future.

The current Hotech SCA Field Flattener is reasonably priced and well-suited for a large part of the imaging market, including most DSLRs and CCD cameras, such as the QSI583ws that I use. So, if you have been troubled by field curvature in your images and are using one of the many compatible cameras, you should certainly consider investing in one. ATT

Image 4: This final image was processed from a stack of images using the author's Borg 125SD at its native focal length, the Hotech flattener, and a QSI583ws camera.