If you’re an amateur astronomer whose “day” begins at sunset, I have a revelation for you: Sun-watching has become a popular pursuit. If you’re not already on the solar bandwagon, you could be missing half your potential observing time.

Studying the Sun also is an essential part of professional research as scientists attempt to understand how stars work. Whether amateur or professional, however, the best way to observe the Sun is to eliminate all but a narrow part, or wavelength, of the light it emits.

DayStar Filters of Warrensburg, Missouri is one of the pioneers in high-quality commercial Hydrogen-alpha (Hα) filter systems for solar viewing. Since 1975, amateur and professional astronomers have used DayStar filters, and they have even orbited in spacecraft.

For this review, I tested the DayStar 0.5 Å Quantum SE filter. DayStar makes two types of Quantum filters. The SE series fills the needs of most amateur astronomers and some in education. The PE series is designed for professional research applications.

The DayStar Quantum Hα filter requires a heated etalon, an optical filter that has a narrow bandwidth at the required wavelength. DayStar produces Hα filter systems in 0.3 angstrom (Å) to 0.8 Å bandwidths in 0.1 Å increments.

An energy-rejection filter attaches to the front of a telescope. It blocks ultraviolet, infrared, and most visible light, reducing the heat on the Hydrogen-alpha filter.

The Hydrogen-alpha wavelength

The most popular narrowband solar-observation wavelength is Hydrogen-alpha (Hα). The Hα emission line occurs when a hydrogen atom’s electron makes a transition from a higher energy level (the third) to a lower one (the second).

The atom emits this energy at 6562.8 angstroms (Å). This allows astronomers to view solar features like prominences and the chromosphere, which glow at this wavelength but are not normally visible. Visually, our eyes detect light in a range from 4000 Å (violet) to 7000 Å (deep red). But to view the Sun in Hα light takes a special filter.

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For the review, I also used a DayStar full-aperture energy rejection filter, or ERF. The ERF mounts on the front end of the telescope. It reduces the heat load on the filter assembly by absorbing or reflecting ultraviolet, infrared, and most visible light. Reducing the heat load lets the Quantum filter function more efficiently. It also gives it a longer usable life. Reducing the amount of energy that strikes the filter helps protect the system’s blocker and trimmer elements, which tend to degrade with use.

I mounted the filter on a 6-inch f/8 Celestron CR 150 HD refractor and a 7-inch Meade f/15 Maksutov telescope. I had to use a Barlow lens with both telescopes to achieve an effective focal ratio around f/30. The system requires such a focal ratio because the light entering the filter must be as close to parallel as possible. Faster f/ratios (below f/30) allow light to strike the filter at steeper angles, providing a sub-par performance.

You can increase your optical system’s focal ratio in two ways: either with a Barlow lens or by employing an aperture mask (which reduces the aperture size, thus increasing the focal ratio). I used a Tele Vue Powermate telecentric system. For the Celestron telescope, I used a 4x Powermate, giving the system an effective focal length of f/32. For the Meade scope, the 2x Powermate provided an effective focal length of f/30.

The complete ERF-telescope-Powermate-Quantum SE filter system was easy to set up because the directions supplied with the filter are foolproof. The Quantum SE filter operates on 12 volts of DC power.

Once the Quantum SE filter powered up, it took about 8 minutes to warm the optics to the proper temperature. As the filter heated up, it reached 6562.8 Å and stopped. The indicator light turned from yellow to green. DayStar’s digital readout clearly showed the current wavelength — a terrific feature!

The readout has an accuracy of 0.1 Å. It can also display error codes, such as voltage variations or internal malfunctions, none of which I experienced during testing.

Through the Maksutov, I quickly determined what proper focus should look like and how to tune the filter using the red and blue buttons. Those buttons change the filter’s wavelength by small amounts. This allows the observer to adjust the filter’s temperature for the best image. Some Hα filter systems tilt the etalon to make this change.

Solar views through the Quantum SE Hα filter were superb. With a little practice, I’m sure I could take great images. Based on my tests, a high-quality, short-focal-length refractor will produce excellent solar images.

A longer-focal-length optical tube assembly would make achieving the f/30 recommended effective focal ratio easier, but the correct Powermate and/or an aperture mask can help you do that. With DayStar’s Quantum SE Hα filter, even a quiet Sun — like we are now experiencing — will look spectacular.

### Specifications

<table>
<thead>
<tr>
<th>DayStar Quantum SE Filter</th>
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<tbody>
<tr>
<td><strong>Type:</strong> Hydrogen-alpha</td>
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<tr>
<td><strong>Bandpass:</strong> 0.5 ångström</td>
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<tr>
<td><strong>Focuser:</strong> 1¼” rack-and-pinion</td>
</tr>
<tr>
<td><strong>Usable f/ratio:</strong> f/30 and higher</td>
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<tr>
<td><strong>Display:</strong> Liquid crystal (LCD)</td>
</tr>
<tr>
<td><strong>Accuracy:</strong> 0.1 ångström</td>
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<tr>
<td><strong>Included:</strong> Power supply</td>
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This full-disk solar image shows a few prominences, but, because we’re near solar minimum, not a great amount of activity. The photographer used a DayStar 0.45 Å Hydrogen-alpha filter to acquire this image. Fred Bruenjes

A solar flare appears white through an Hα filter. The small, dark areas above and to the right of the flare are sunspots. The photographer used a DayStar 0.45 Å Hydrogen-alpha filter to acquire this image. Fred Bruenjes

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The Quantum SE filter has a digital wavelength readout. The red and blue buttons tune the wavelength up and down precisely. Astronomy: James Forbes

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Contact information

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Fred Bruenjes
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