

**Product Specifications:**

**The ATM series** filter system is designed to meet the needs of most amateur solar observers.

*Clear and usable aperture:* 32 mm. (1.25").

*Bandwidth measurement:* 19 mm. (0.75") central aperture.

*Fully blocked transmittance:* 4%-8% of polarized light. Lower values correspond to narrower bandwidth filters.

*Off-band rejection:* Average optical density greater than 6.0 from X-ray to beyond 2.0 microns .

*Optical components:* Selected instrument quality.

Air-glass interfaces are anti-reflection coated in the filtering assemblies.

**The University series** filtering system is designed for serious research programs requiring full aperture spectral uniformity. Systems are fabricated from the finest optical and filtering components available.

*Clear and usable aperture:* 32 mm. (1.25"). (50mm models available on request)

*Bandwidth measurement:* Full aperture 32 mm. (1.25").

*Fully blocked transmittance:* 4%-10% of polarized light. Lower values correspond to narrower bandwidth filters.

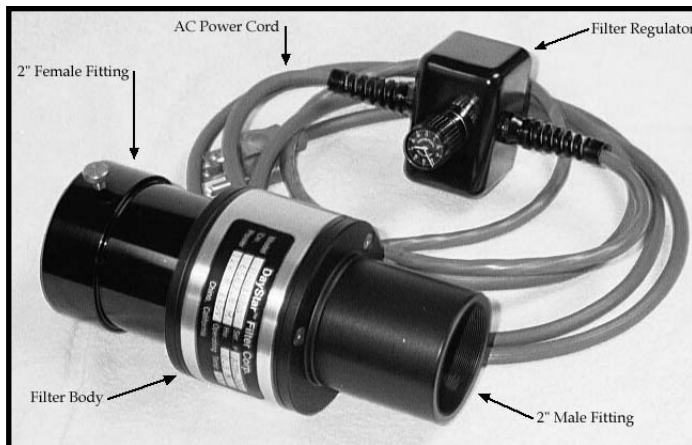
*Spectral uniformity:* The peak wavelength of any 12 mm. dia. area shall be within  $\pm 0.05 \%$  of the full aperture wavelength measurement.

*Off-band rejection:* Average optical density is greater than 6.0 from X-ray to beyond 2.0 m .

*Optical components:* BK-7 grade A, fine annealed 60-40 scratch-dig. Each optical element other than the etalon has a maximum wave front distortion of  $1/4\lambda$  @ 5461 \Hg.

Air-glass interfaces are V-coated for a maximum of 0.2% reflectance per surface at the designed wavelength.

**The T-Scanner series** filter system is designed for visual observers requiring effective filtration without access to AC power. Optical specifications are identical to the ATM series with the exception that the filter clear aperture is reduced to 30 mm. (1.18")



# DayStar Filters Hydrogen Alpha Solar Filter Systems

## Operating and Instruction Manual



149 Northwest OO Highway - Warrensburg, MO 64093  
www.DayStarFilters.com - 660.747.2100

## Introduction to the DayStar Filter use and configuration:

### **NEVER POINT A TELESCOPE AT THE SUN WITHOUT THE COMPLETE FILTER ASSEMBLY IN-PLACE.**

The DayStar Narrow Bandpass Filter system can be used with a choice of configurations and telescopes. The filter has several important considerations in order to function properly and to produce optimum results. Careful use and application of these configuration requirements will produce very high quality observing and / or photographic conditions.

Light entering the filter must arrive at F/30 in order to function properly. This focal ratio is required in order to achieve a more parallel light path. Unparallel light entering at an angle will not deliver optimum narrow bandpass results. Because very few telescopes are manufactured at F/30, the telescope configuration must incorporate a choice or combination of two methods to achieve this.

- a. Aperture Reduction: A telescope's focal ratio will be increased in the proportion that the aperture is decreased. An easy way to compute the proper size is to **DIVIDE THE EFFECTIVE FOCAL LENGTH (EFL) BY 30**. A 900mm EFL telescope would need a 30mm masked aperture to achieve F/30. This is a common means for use with large apertures like catadioptrics. Aperture reduction will not reduce the EFL or alter the image size of the Sun's disk. It will, however, reduce the resolution of the image.
- b. Use of barlows: A barlow will change the focal ratio of the light exiting a telescope. A 2x Barlow will change light exiting an F/8 to a F/16. A 4x Barlow will change F/8 to F/32. Use of barlows will increase the Effective Focal Length. EFL and resulting image size and resolution of the Sun's disk.
- c. Combination of both techniques: These methods can be used in cooperation to achieve the same results. By example: A 100mm aperture F/8 can have a 50mm aperture reduction **AND** a 2x Barlow to achieve F/30

A few words of warning about each technique:

When using the aperture reduction technique on a Catadioptric, Mosutov or any other off-axis application: Reduction of the aperture off the center axis will cause the light to leave the telescope at a slight angle. **ALL OFF-AXIS APERTURE REDUCTIONS MUST USE AN APPROPRIATE WEDGE PLATE** in order to compensate for this angle of entry. Telescopes less than F/15 will need the 1.9 degree wedge plate. Questars and telescopes at F/15 or higher must use the 1.2 degree wedge plate.

When using the Barlow system, single element negative Barlow lenses cause a vignetting effect. This will cause the outer field of view to darken and fall off-band. For most effective, full-field observations, be sure to use a telecentric Barlow like the Televue Powermate style negative lenses .

#### **Use of the ERF:**

The energy rejection filter (ERF) is required to reduce the overall heat load entering your telescope. These filters are currently made of optical quality red or yellow glass. Other specialty coatings specific to the bandpass can be produced for university settings.

Frequently, the ERF aperture and cell is used to reduce the telescope aperture and bring the telescope to F/30. The ERF will be designed in one of the following 3 styles:

#### III: Finding the Sun:

With your filter installed, finding the Sun can be a challenge. Here are some tips to help you become more skilled at this task. First, we recommend the same system you would use for locating nighttime objects; a finder scope (with white light solar film) or a special solar-finder alignment tool. This will consist of 2 coin-sized plates mounted parallel to each other. Televue manufactures such a solar finder tool. A hole in the front disk causes a pin-hole to appear on the back disk. Once the Sun is achieved in the eyepiece, align the tool so that this dot falls on a cross-hair. Also, when the sun is shining, the shadow of the telescope itself is a good alignment tool. Pointing the telescope directly into the Sun will make its shadow smaller and perfectly round. Off-axis, the shadow will elongate. Move your telescope and watch the shape of its shadow. Before long, you will be very skilled at proper alignment this way. **Do not look through a telescope pointed at the Sun without a solar filter!**

#### IV: Photographing in Hydrogen $\alpha$ :

Photographing the Sun can be very rewarding, but also frustrating. Digital photography adds new techniques, but real film also still performs very well for Hydrogen Alpha. It is important to consider the red sensitivity of your film or camera's chip. Many films and chips are developed to reduce the red sensitivity in the spectrum. Your goal is to maximize that red sensitivity. We recommend the use of black and white Technical Pan 2415 as the highest sensitivity, resolution and contrast for photography in hydrogen alpha. Digital photography has advantages also. Be aware that parallel light associated with these filters has a tendency to cause internal reflections on digital camera surfaces and lenses. Many digital SLR cameras have a protective glass plate mounted in front of the CCD sensor. This causes an internal reflection on the image. Also, most digital cameras are programmed to reduce the red sensitivity of the chip. Research your camera's capacity to know what its specifications are.

Digital cameras, CCD cameras, camcorders and webcams can be mounted to photograph at prime focus or with eyepiece projection. Consider your field of view for selection of a camera and/or eyepiece. Your telescope's configuration will dictate the effective Focal Length and image size. A myriad of configurations is possible in achieving different fields of view. Consider Dawes limit when extending your field of view beyond 1 arc second. Your local seeing conditions will ultimately limit your resolution capacity.

#### V: Observing conditions:

Daytime seeing conditions can vary greatly from those at night. In general, a stable seeing environment will not have turbulence created by wind, terrain, smog, or thermal heating cells. Heat created through solar radiation causes convection, which generates upward air currents during the day. More heating cells cause more turbulence in the atmosphere. Avoid observing over areas which gain heat such as blacktop parking lots, over tar roofs and other ambient heat sources. Different conditions occur at different times of the day. Your local conditions and circumstances will vary independently.

#### **Warranty of DayStar Filter products:**

Used as directed, the DayStar Hydrogen-Alpha filter is guaranteed to operate on-band for a period of TEN (10) years from the date of delivery. Should the filter become inoperative due to optical or electronic failure, **DO NOT** open the filter assembly. Return the filter to DayStar at 149 Northwest OO Highway, Warrensburg, MO 64093. DayStar will repair or replace the filter assembly at no cost to the customer.

T-Scanners: Your T-scanner operates on-band at an ambient temperature of 72-75° F with consideration to tilt. The tilt knob alters the angle at which the light enters the filter stack. The tilt changes the band-pass transmission of the filter up to 1 angstrom and will be necessary to tune your filter to the proper bandwidth. The tilt allows for blue and red wing exploration by turning the knob. Use caution with tilt controls. Excessive tilt can cause an internal reflection. If the ambient temperature is not 72-75° F degrees, the filter will not operate on-band. If the T-scanner is used without a proper ERF, excess heat gain in the telescope will cause the T-scanner to increase in temperature beyond the operative temperature for the filter.

### Mounting the Filter on your telescope:

The YELLOW side of the filter points towards the Sun  
The RED side of the filter points towards the eyepiece.  
**YELLOW -> SUN : RED -> EYEPIECE**

- Each Filter assembly must be configured individually with front and rear fittings. If you are using off-axis aperture reduction, you will need a wedge-plate attached directly to your filter - on the YELLOW side. On Oven Models: Note that the thick edge of the wedge should mount oriented opposite of the chord. The rear of the oven model also requires a thread-plate which accepts a draw tube snout. Oven models use TWO levels of plates in order to mount properly. T-scanners just use one. T-scanners already have threads to accept this draw tube. However, in off-axis applications, the yellow-side end plate must be exchanged for a wedge end-plate.
- Once your end plates and draw tubes are in place, cross check the ERF. Be sure the ERF is firmly fixed to the front element of your telescope.
- Plug-in your oven model to a grounded 110VAC power source and set the temperature control position to 6 to pre-heat for 10-15 minutes.
- If using a Barlow, assemble the Barlow directly behind the focusing tube, then insert the filter after the Barlow - Yellow-side towards Sun. Be sure to orient filter wedge and/or cord in conjunction with off-axis ERF opening. Hole up/ cord down.
- Insert eyepiece and locate the Sun in the field of view. (see tips on locating the sun) and achieve focus. Note that focus point using a Barlow may be significantly farther back than previous points.
- **NEVER POINT A TELESCOPE AT THE SUN WITHOUT THE COMPLETE FILTER ASSEMBLY IN-PLACE.** Do not use the telescope without the filter to locate the Sun or to find focus. Pointing a telescope at the sun without filtration will cause serious eye injury or blindness.

Note: Often, wide-field eyepieces are difficult for first-time viewers. The viewing angle usually requires the observer to move his eye around until the sun's red disk comes into view. Please see focus in the tip section on next page.

### Maintenance of the Filter:

**There are NO user-serviceable parts inside your DayStar Filter assembly.**

Store your filter in a cool, dry and dark environment. Keep end caps on the filter or store the filter in a plastic bag to keep dust off the end elements. If humidity is high, use desiccant in the sealed container to discourage fungus environments.

- The exterior of the filter can be cleaned with a soft, lint-free cloth. We recommend eyeglass cleaning cloth for the housing of the filter, as it will not introduce lint into the filter.
- Dust and particles should be removed by air with a bulb aspirator or "Dust-Off" cleaning spray. We discourage blowing on your filter to clean it.
- End elements of the filter occasionally have smudges from human contact. Smudges do not affect filter performance much, as the end elements have an anti-reflective coating to minimize these effects. Usually cleaning these smudges is ineffective and only worsens the situation. Optical couplant grease surrounds the filter and using a cloth to clean this surface typically only re-introduces this grease onto the filter's surface. Alcohol can be used with extreme caution on a sterile lint-free swab with some success.
- **Do NOT open the filter to clean it.**

Periodic check for aging components:

Your filter contains 2 elements which age and darken over time. This usually takes more than 10 years. Filters in high temperature or high humidity environments fail faster. We have seen some filters operate flawlessly for 25 years. When these two blocking and trimming filters fail, they darken from the outside in. Component failure can NOT cause the filter assembly to become un-safe. To the contrary, the filter will allow LESS light through upon failure. If you suspect blocker and trimmer failure, you can check your filter for signs of aging with a visual inspection.

With the filter detached from the telescope, hold the filter up and look into the Red end. Tipping it back and forth, watch for a doughnut shaped fogging. This occurs slowly over time. The filter will operate very well as this fog slowly evolves, but the image eventually gets darker and darker in the shape of the fog. This failure is accelerated by heat.

Also, on the other yellow/gold end, tip the assembly back and forth to examine this element. On this end, we are checking for spots. A failed element on this end will develop a subtle ring of mold-like foggy spots. This element fails more slowly than the red element. However, it is more susceptible to failure in humid environments.

If your filter has darkened and become fuzzy, and demonstrates these signs of failure, the blockers and trimmers will need replaced. If your filter is still under warranty, we will replace them at no cost (less shipping). If the warranty has expired, there will be a moderate fee. Please check the website, [www.DayStarFilters.com](http://www.DayStarFilters.com) for current rates for this service.  
**Do not open your filter to attempt this repair yourself.**

**There are NO user-serviceable parts inside your DayStar Filter assembly.**

Do not open your filter for any reason to clean or service the filter. Filter assemblies should only be opened in optical clean room conditions and by qualified DayStar service technicians.

Damage caused by opening the filter seen to date include:

- Mechanical parts lost or misaligned

- Introduction of airborne particles, dust, lint, animal hair or foam particles
- Separation of filter elements which require laboratory re-assembly
- Mis-alignment, or turning optical elements upon each other which requires complete laboratory re-build of elements
- Exposure of Etalon crystal to elements causing permanent filter failure
- Turning surfaces in contact with etalon crystal causing permanent filter failure
- Breaks or chips in filter elements.
- Damage to high voltage heater and/or wiring components

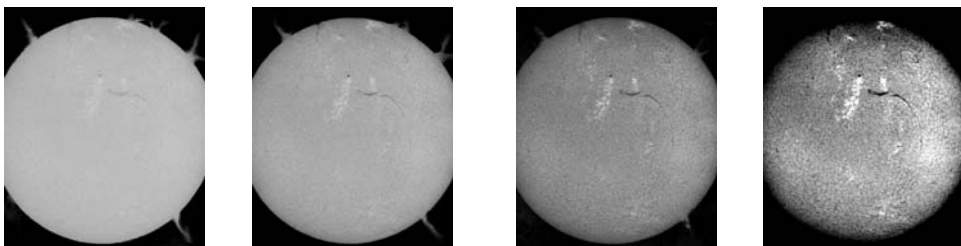
**None of these failures are covered under warranty. Please do not open your filter, as there is no repair or service which can improve the function or repair of your filter which can be done by the user.**

### Observing the Sun in Hydrogen Alpha:

#### I: Why Hydrogen Alpha?

This bandwidth: 6562.8 Angstroms is an absorption line of Hydrogen. When we observe the Sun in only this wavelength, we can eliminate all of the other very bright light being emitted and see the activity interacting in Hydrogen, transmitting in this wavelength. We make our filters to view ONLY this very narrow bandpass, and to exclude everything else. The more excess light we exclude, the more contrast and detail emerges in our desired bandpass. Detail will increase photographically and with new, modern image stacking and editing capacities.

- A 0.8-0.95 \filter shows prominences on the sun's limb.
- A 0.7 angstrom filter shows good detail of limb activity, such as prominences and also spicule.
- A 0.6 \filter can show prominences and some large surface detail.
- A 0.5 \filter will show much better detail of the sun's surface including, granulation, light bridges, magnetic oscillations in connection with sunspot activity
- A 0.4 \filter will show high contrast surface detail, but will also allow viewing of the delicate chromosphere.



0.9 \filter

0.7 \filter

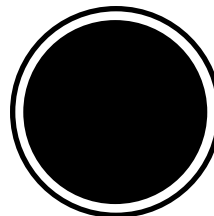
0.6 \filter

0.5 \filter

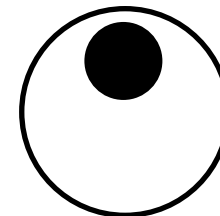
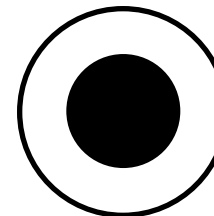
#### II: Activity:

Hydrogen Alpha in high resolution is a wonderful way to observe activity on the Sun over a long period of time. But some activity such as shapes of prominences or spicule change very quickly. Prominences change shape as quickly as every 10-15 minutes. Spicule have a lifespan of only a few minutes each. Sunspot activity and its surrounding phenomena can be watched over long periods of time as they move across the Sun in its rotation. This activity can be viewed face-on, moving to the sun's limb to be seen in profile. Sunspot groups can also return after a full rotation of the Sun brings them around again. We recommend that observers explore information sources about Solar Activity. The Astronomical League offers a Sunspotter award for solar observing.

Full Aperture ERF



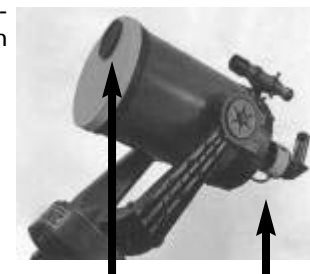
On-Axis Aperture Reduction ERF



OFF-Axis aperture reductionERF

Use of the telescope without an ERF will cause excess heat gain inside the telescope and to the filter mechanism. The filter will heat beyond the proper operating temperature and cause the filter to change bandpass. Excess heat exposure will cause premature failure of the blockers and trimmers and void their warranty.

NOTE: For Oven Models, the off-axis Aperture reduction ring MUST be aligned properly in conjunction with the wedge plate. The ERF opening must oppose with the direction the POWER cord of the Filter points. Ex: If the hole in the ERF cell is points to the 6:00 position or down, the cord of the filter should point up. Hole UP, Cord Down or Hole Down, Cord UP.



Hole Up, Cord Down

If you examine the wedge thicknesses, you will see that the thick part of the wedge is then corresponding with the direction of the ERF opening.

If you have a T-scanner without a chord, you will need to examine the wedge plate more carefully. Orientation of the THICK side of the wedge plate should be the SAME as the opening in the ERF.

**IF YOU DO NOT USE OR PROPERLY ORIENT YOUR WEDGE PLATE, YOUR FILTER WILL BE OFF-BAND. IMPROPERLY ORIENTED WEDGE PLATES ALSO CAUSE INTERNAL REFLECTIONS.**

#### Temperature Control:

Your Hydrogen Alpha filter is designed to operate at a specific temperature. That exact temperature is individual to each filter and etalon crystal. No two etalon crystals are identical.

Oven Models: We have individually tested and fixed the heat setting on your oven model filter to operate at setting 6 on your temperature control knob. Changing the setting up or down in temperature will move the filter on and off-band. A slight change in setting - as little as to a 4 - will cause the filter not to operate on-band. You may feel free to explore blue/red wing shift in this range. Please do not operate the filter above 9. Excess heat will cause premature failure of the blockers and trimmers and void the warranty.

Oven models function on 110VAC. Temperature controls contain a high voltage temperature control circuit which currently cannot operate from an inverter. Please check the website [www.DayStarFilters.com](http://www.DayStarFilters.com) for any future updates on heater control voltages.