DAYSTAR FILTERS

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.

- 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.
- 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.
- 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 Catadioptic, Maksutov 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:

Full Aperture *(lower left)*
Reduced Aperture On-Axis *(lower right)*
Reduced Aperture Off-Axis *(top rear)*

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 application with off-axis ERF and your T-Scanner, 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.

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 and causes the wavelength to the blue wing of up to 1.5Å. This allows you to operate your filter in a slightly broader temperature range - from approximately 65° to 85° F.

The tilt also 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 below 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 off-axis applications: Note that the thick edge of the wedge should mount oriented opposite of the off-axis hole. 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.

If using a Barlow, assemble the Barlow directly behind the focusing tube, then insert the filter after the Barlow - Yellow-side towards Sun. If using a diagonal and a barlow, insert the barlow and DayStar after the diagonal for an easier time reaching focus. - Insert eyepiece and locate the Sun in the field of view. and achieve focus.

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.

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. -

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. 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 reintroduces this grease onto the filter's surface. High % Isopropyl 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 at a bright incandescent light or the sun itself. 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 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-.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. Promimences 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.

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 α

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.