ASTRONOMY HACKS™

Tips & Tools for Observing the Night Sky

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O'REILLY™

HACK #58 Enhance Lunar and Planetary Contrast and Detail

Choose a basic set of filters to improve the view.

Just as photographers use filters to alter the images captured by their cameras, astronomers use filters to alter the images visible in their eyepieces. A filter, by definition, can add nothing to an image; it can only take away. But, like the sculptor who creates an elephant from a block of stone by cutting away everything that doesn't look like an elephant, an astronomer may use filters to create more detailed views of some objects by removing extraneous light to allow the subtle details of the object to show through.

Astronomical filters are available in several sizes. The most common are those that fit standard threads on 1.25" and 2" eyepieces and the visual backs of Schmidt-Cassegrain Telescopes (SCTs). Meade goes its own way, using a non-standard thread on their 1.25" and 2" eyepieces and filters, and Questar uses still a different thread. A few filters are available for 0.96" eyepieces, which are common in Japan and with some old telescopes but rare elsewhere. Filters for 1.25" eyepieces are available in by far the widest variety. The selection for 2" eyepieces is somewhat more limited, and those for SCT visual backs are even more limited.

If you use both 1.25" and 2" eyepieces, consider buying only 2" filters. Although a 2" filter cannot be attached directly to a 1.25" eyepiece, there are two common workarounds. First, many 1.25"/2" focuser adapters provide threads for mounting a 2" filter, which can then be used with any 1.25" eyepiece you insert into the adapter. Second, if you have a Newtonian (or Dobsonian) reflector, you can install a filter slide, which attaches to the inside of the tube between the bottom of the focuser and the secondary mirror. With a filter slide, you can quickly position any of several filters under the focuser simply by moving the slide. Finally, of course, you can simply hold a 2" filter between your eye and the eye lens of the eyepiece, assuming the eyepiece provides sufficient eye relief.

Enhancing Color Contrast

Color filters, sometimes called *planetary filters* or *Lunar/planetary filters*, are simply discs of colored glass, ground optically flat on both sides and with antireflection coatings applied to both surfaces. By selectively transmitting parts of the visible spectrum and blocking other parts, color filters can enhance visual contrast and detail in bright objects like Luna and the planets. All color filters use the century-old Kodak Wratten numeric designa-

tions familiar to photographers. Any two filters that have the same Wratten designation, regardless of manufacturer, have similar or identical transmission characteristics.

Transmission curves are available for all Wratten color filters. These curves graph the transmission (or its inverse, the density) of a filter across the visible spectrum. Figure 4-31 shows an example transmission curve, this one for a #58 Green filter. The same data may be presented in tabular form, as shown in Table 4-7. These data tell us that the #58 Green filter passes most of the green light, with maximum transmission centered on about 530 nanometers (nm). Blue-green wavelengths are attenuated, and everything shorter than about 465 nm—blue through ultraviolet—is blocked completely, as are yellow through red wavelengths from about 620 nm (orange) through 700 nm (deep red). At about 700 nm, the #58 Green filter begins providing higher transmission, reaching nearly 100% at wavelengths of 800 nm (infrared) and higher.

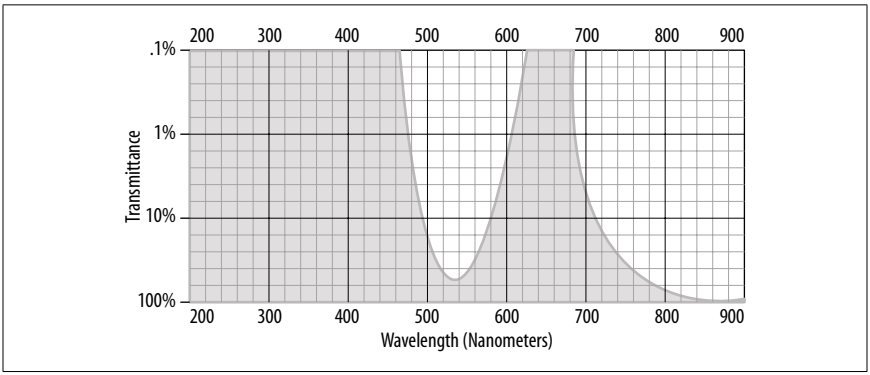

Figure 4-31. Transmission curve of a Wratten #58 Green filter

Table 4-7. Transmission data for Wratten #58 Green filter

Wavelength	Percent transmittance
400	--
10	--
20	--
30	--
40	--
50	--
60	--
70	0.23
80	1.38
90	4.90
500	17.70
10	38.80
20	52.20

Table 4-7. Transmission data for Wratten #58 Green filter

Wavelength	Percent transmittance
30	53.60
40	47.60
50	38.40
60	27.80
70	17.40
80	9.00
90	3.50
600	1.50
10	0.41
20	--
30	--
40	--
50	--
60	--
70	--
80	--
90	--
700	0.53

Some experienced Lunar/planetary observers swear by color filters, while others (including us) find them of very limited use. Although a filter changes the appearance of the object dramatically—a #25 Red filter, for example, turns everything bright red—the degree of contrast and detail enhancement is usually quite subtle. Color filters are not a magic bullet for enhancing Lunar/planetary observing, but they are relatively inexpensive and you may find the enhancements they provide worth their small cost.

Consider transmission percentage when you choose color filters. Small telescopes provide dim images at Lunar/planetary powers even without a filter; if you add a dense filter, the image may darken unacceptably. At 25X/inch to 30X/inch magnification, which is to say typical Lunar/planetary powers for mid-size scopes, we think you'll find any filter with transmission less than 15% or so to be too dark to use. At 40X/inch to 50X/inch, typical Lunar/planetary powers for small refractors and similar instruments, any filter with transmission less than 40% to 50% is likely to dim the image unacceptably.

We think the four color filters listed in Table 4-8 are most useful for general Lunar/planetary observing with mid-size to large telescopes. You can buy them individually for $10 or $15 each in 1.25" or $20 to $25 each in 2" ver-

sions. Some astronomy specialty vendors sell this or a similar selection as a set, often at a significantly lower price versus buying them individually.

If you want to start with just one color filter, we think the #80A Medium Blue is the best choice for mid-size or larger scopes. Although it is not necessarily the best choice for any one purpose, it is helpful for many objects, from Luna to Venus to the superior planets. The #80A even serves as a "poor man's" light pollution filter, somewhat reducing the yellow-pink skyglow caused by low-pressure sodium vapor lights. Unfortunately, the #80A is often a bit too dark for 4.5" and smaller scopes, particularly at high power. For such scopes, we recommend the #15 Deep Yellow as the best general-purpose filter. The #82A Pale Blue is a jack of all trades, and it would be our second or third choice for any size scope.

Table 4-8. Basic color filters

Wratten	Color	Transmission	Improves
#15	Deep Yellow	67%	Lunar feature contrast/terminator; Venus clouds; Mars clouds/ice caps; Mars, Jupiter, Saturn feature contrast; Uranus/Neptune detail
#58	Green	24%	Venus clouds; Mars ice caps; Jupiter GRS; Saturn clouds/belts/polar regions
#80A	Medium Blue	30%	Lunar surface detail & feature contrast; Venus clouds; Mars clouds/ice caps; Jupiter belts/rilles/festoons/GRS; Saturn belts/polar regions; reduces low-pressure sodium-vapor light pollution; most generally useful color filter
#82A	Pale Blue	73%	Luna/Mars/Jupiter/Saturn low-contrast features/detail; Jupiter/Saturn cloud belts; comet tails; reduce refractor false color; structure/detail in bright galaxies

Table 4-9 lists the four filters we consider most generally useful after the basic set. The #47 Violet, although it is too dense for use in small scopes, is probably the best overall choice for viewing the inferior planets, particularly Venus. The similarly dense #25 Red lightens warms colors and darkens cool colors dramatically, and it is the best choice when you need a deep-cutting contrast filter. The #11 Yellow-Green and the #21 Orange straddle the #15 Deep Yellow in both density and effects.

Table 4-9. Supplemental color filters

Wratten	Color	Transmission	Improves
#11	Yellow-Green	78%	Venus clouds; Mars maria/ice caps; Jupiter/Saturn clouds/feature contrast; Saturn Cassini Division; Uranus/Neptune detail/contrast

Table 4-9. Supplemental color filters (continued)

Wratten	Color	Transmission	Improves
#21	Orange	46%	Mercury/Venus contrast against daytime sky; Mars maria; Jupiter/Saturn belts/festoons/polar regions; color correction with Mylar Solar filters; similar to #15 but with lower transmission and higher contrast
#25	Red	14%	Mercury features/contrast; Venus clouds/contrast/terminator; Mars maria/ice caps/surface detail; Jupiter clouds/belts/transits; Saturn clouds
#47	Violet	13%	Lunar detail; Mercury/Venus clouds/contrast/detail (many observers' first choice for Venus); Mars ice caps; Saturn ring structures

If you have the Basic and Supplemental sets and still feel the need for more color filters, consider one or more of those listed in Table 4-10. In general, filters in this group simply fine-tune the effects of the more commonly used filters. We consider all of these filters highly optional, so much so that we no longer own any of them.

Table 4-10. Less frequently used color filters

Wratten	Color	Transmission	Improves
#8	Light Yellow	83%	Moon features/contrast; Mars maria; Jupiter/Saturn belts; Uranus/Neptune detail; comet tail/coma detail; similar to #12 but with higher transmission and less pronounced effects
#12	Yellow	74%	Moon features/contrast; Mars maria; Jupiter/Saturn belts; Uranus/Neptune detail; intermediate between #8 and #15 in transmission and effects
#23A	Light Red	25%	Mercury/Venus sky contrast in daylight/twilight; Mercury features/contrast; Venus clouds/contrast/terminator; Mars maria/ice caps/surface detail; Jupiter clouds/belts/transits; Saturn clouds; similar to #25 with higher transmission and less pronounced effects
#29	Deep Red	8%	Mercury/Venus sky contrast in daylight/twilight; Mercury features/contrast; Venus clouds/contrast/terminator; Mars maria/ice caps/surface detail; Jupiter clouds/belts/transits; Saturn clouds; similar to #25, but much darker and with more pronounced effects
#38A	Deep Blue	17%	Venus clouds; Mars dust storms; Jupiter belts/GRS; Saturn rings/belts/clouds; bright comet tails
#56	Light Green	53%	Lunar detail; Mars dust storms/ice caps/clouds; Jupiter clouds/low-contrast detail; Saturn cloud/surface detail

If you want to try different filters before plunking down $10 or $20 each for mounted glass filters, you can use thin-film acetate filters to judge the approximate effect of different Wratten glass filters. A set of 100 acetate color filters is available for under $10 from Scientifics Online (*http://scientificsonline.com*), formerly known as Edmund Scientific.

Dimming the Image

Neutral-density (ND) filters and *Polarizing filters*, sometimes called *moon filters*, are used when you need to dim the image, for example, as if you are viewing Luna at low power. ND filters are available in various fixed densities from quite light to very dark, and are simply dyed glass filters with a neutral gray shade. ND filters may be labeled by their percentage transmission (e.g., an ND50 filter has 50% transmission and an ND25 25%) or logarithmically (e.g., an ND 0.3 filter has 50% transmission, an ND 0.6 25%, and an ND 1.0 10%).

Some filters marketed as "moon filters" combine neutral density with color filtration. For example, we have one "moon filter" of unknown provenance that appears to provide the combined effects of an ND50 filter with a #58 Green or #56 Light Green Wratten filter.

Polarizing filters are, in effect, variable neutral-density filters. They comprise two layers of Polarizing material in a mount that allows the layers to be rotated relative to each other. As you change the relative position of the Polarizing layers, the visible neutral density varies from moderate to high.

We consider neutral-density and Polarizing filters to be useless except in vary large instruments. Part of that, we suppose, is because the primary purpose of a telescope is to gather light, and most astronomers consider "wasting light" to be stupid, if not downright sinful. But the real reason is that there are better alternatives. If, for example, Luna is too bright in your eyepiece, that's nature's way of telling you to use more magnification, use a contrast filter, or both.