10mm Pentax XW vs. 10.5mm Pentax XL

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Editors Note

We wish to thank Gary Hand of [Hands on Optics] for lending us the Pentax XW for several months of testing. Thanks Gary!

The amateur astronomy community has been awash in rumors for the last several years that Pentax would be coming out with new astronomical eyepieces. Finally, the dam broke. In early summer of 2003, Pentax deluged us with two new orthoscopic eyepieces (the 5mm and 2.5mm Pentax XO) and a complete set of eight widefield eyepieces, the Pentax WX series (almost immediately renamed “Pentax XW" to stand for “extra wide"), to replace their highly regarded XL series.

This review compares the Pentax 10mm XW with the 10.5mm Pentax XL. I have no connection with

Pentax or with any Pentax dealer. Allister St. Claire, webmaster extraordinaire for Cloudy Nights, arranged with Gary Hand at Hands-On-Optics for me to borrow a 10mm Pentax XW for this review, and loaned me his own 10.5mm Pentax XL.

Playing the numbers

The eight new Pentax XW eyepieces have the much-desired 20mm eye relief of their predecessors and come in a broad range of focal lengths, as noted in the table below. These changes have resulted in a higher power 3.5mm eyepiece for potential planetary use, and a new 30mm 2" eyepiece to address the often-criticized 28mm XL's narrow apparent field of view (55 degrees) compared with the other XL's (65 degrees).

Pentax XW			***Pentax XL***		
	Elements/ Groups	***Weight***		***Elements/ Groups***	***Weight***
40mm (2")	6/5	700g/24.7 oz.	40mm (2")	5/5	380g/14 oz.
30mm (2")	7/6	740g/26.1 oz.	28mm	5/4	340g/11.9 oz.
20mm	6/4	355/12.6 oz.	21mm	6/4	325g/11.3 oz.
14mm	7/6	365g/12.9 oz.	14mm	6/4	360g/12.6 oz.
10mm	7/6	390g/13.8 oz.	10.5mm	6/4	380g/13.3 oz.
7mm	8/6	390g/13.8 oz.	7mm	7/5	425g/14.8 oz.
5mm	8/5	395g/14 oz.	5.2mm	7/5	440g/16 oz.
3.5mm	8/5	405g/14.3 oz.	-	-	-

Indeed, the apparent field of view had been an issue for the other Pentax XL's as well. For some people whose eyes had gotten used to the 82-degree wide fields of Naglers and the 68-degree wide fields of Panoptics, the XL's 65-degree field of view seemed constricted even more than the numbers would suggest. The new XW eyepieces were designed to address that criticism with a 70-degree AFOV.

Compared to their XL counterparts, all but one of the XW series have more glass elements and three have more groups, meaning more air-to-glass surfaces. Despite the extra glass and surfaces, however, the new XW's claim better light transmission than the XL's, a total of about 98% of visible light. The XW's also use lanthanum glass elements to improve performance. Both series of eyepieces have Pentax Super Multicoatings (SMC) on all air/glass surfaces, but the XW eyepieces have special "partial coatings" on the cemented surfaces that are intended to improve light transmission and reduce scatter from bright objects. They are also waterproof to the extent that dew won't hurt them (but don't throw one into the lake).

There's also a difference in weight. The shorter focal lengths (5 and 7mm) of the XW's are lighter than the XL's, the intermediate focal lengths (10 and 14mm) are essentially the same, and in the longer focal lengths, the XW's are heavier. The biggest differences are at 30mm, where the 2" XW is almost a pound

heavier than the 1.25" 28mm XL, and at 40mm, where there's an 11 ounce difference.

The other difference in the numbers is price. When last sold at retail, the Pentax XL's ran about $249, with the 40mm XL at a similar price or slightly higher. The Pentax XW's, however, are about $339 for the 1.25" versions and $549 for the 2" versions. Consider the XW's a major commitment of resources.

The tests and the objects tested

The 10mm Pentax XW and 10.5mm Pentax XL eyepieces were compared in three telescopes over a range of focal lengths and f-ratios. First warning: I believe that the choice of telescopes affected the test results. A 10mm Radian and 10mm TMB Super Monocentric joined the comparison at various points as well. The powers were a compromise to give a reasonably good image size for the various objects viewed, which ranged from Mars to the double cluster. The powers for the 10.5mm XL are about 5% lower than the powers given for a 10mm eyepiece in the chart below. This power difference could potentially have a minor effect on such things as background darkness, which is usually darker in higher power eyepieces.

	Focal length	***f-ratio***	***Power***
Takahashi Sky 90, 90mm apochromatic refractor	800mm	8.9	80x
with 1.6x Extender-Q	1250mm	13.9	125x
with 2.5x Powermate			
10" dobsonian, optics by Mike Spooner	1380mm	5.6	138x
20" Obsession dob, Nova optics	2540	5.0	254x

The objects tested were:

- An artificial star, to examine sharpness, coma and astigmatism across the field.
- The moon, to examine high contrast surface features and sharpness.
- Mars, to test resolution of low-contrast surface features.
- M13, for resolution of dim stars in the globular cluster.
- M57 (the Ring nebula), M8 (the Lagoon nebula) and M17 (the Swan nebula) to see how well dim fuzzies with structure would stand out from the background sky.
- The double star Polaris and the double-double in Lyra, for cleanness of the split, scatter and the star images.

But as is my habit, I looked at them indoors first.

At the dining room table

The new XW comes in a plain green Pentax box. Inside, the XW eyepiece is in a cylindrical plastic bolt case vs. the XL's square two-part plastic box. As for the eyepieces themselves, not only are they similar in color (flat black) and weight (the XW is half an ounce heavier), but they're almost identical in size.

The main difference is the size of the eye opening at the top of the adjustable aluminum eyeguard. The opening at the top of the XW is considerably larger, although it's still easy to position your eye against the eyeguard. Like the XL, the XW's eyeguard screws up and down, and stays put as you handle the eyepiece. The XL's eyeguard was almost smooth, while the XW's has distinct vertical ridges. This looks good and makes it easier to grip the eyepiece. However, like the XL, the XW is too wide to conveniently use in a binoviewer.

Looking at light throughput by holding the two eyepieces up to a brightly illuminated piece of paper, the two Pentaxes tied. There was nothing to choose between them except that the XW, of course, had the wider field of view.

Test #1: The artificial star

I used an artificial star to have a more controlled image for comparison, setting up the Sky 90 at f8.9 with focal length extenders for straight through viewing about 35 feet away. I looked at both the pinhole image in focus and at three diffraction rings on either side of the focal point. The percentage indicate when the images started to deviate from “perfect."

As anticipated, the artificial star was quite sensitive at detecting distortions, and the Pentax XW had more distortions than the XL. Some of these distortions appeared to show up during observations of different astronomical objects, and some did not. Using a different telescope could also have affected the results. Please keep in mind that the numbers in the chart do NOT indicate a major flaw in the eyepieces, and are similar to what I'd be reporting if I were evaluating other widefield eyepieces.

	Pentax 10mm XW	***Pentax 10.5mm XL***
Diffraction rings “spill" toward axis	75% from axis	75% from axis
Pinhole image initial distortion	50% from axis	75% from axis
Pinhole image 10% from edge of field	4x as long as wide	2x as long as wide

Test #2: The moon

The moon provides an opportunity to see high contrast surface detail. On both eyepieces, on-axis detail was wonderfully sharp and there was nothing different between them. Lunar shadows were dark black,

not charcoal colored, as I'd sometimes seen in other widefield eyepieces. Texture and ability to reveal differences in the gray lunar surface also seemed about the same with each. That performance continued right to the edge of the field of view on both Pentaxes. The sky seemed equally dark off the limb of the moon for both as well.

When I was first testing Pentax orthos, I noted a very slight greenish tinge at the limb of the moon. Sure enough, there it was with the XW and the XL, too. It was minor, but visible on both starting from about 80% of the way from the axis to the field stop. The phenomenon persisted in both the reflector and the refractor and did not exist with the Radian, so it isn't due to the telescope itself. It's not terribly obvious and doesn't interfere with surface detail, but it's there.

Test #3: Mars

Some reviewers have found Pentax XL's to be questionable in viewing low-contrast planetary detail because of the amount of light they scatter. So one question I had was whether the Pentax XW's had less scatter than the XL's that might result in improved planetary viewing. I used a 10mm TMB Super Monocentric as the reference standard, and a 10mm Radian for a brief comparison.

In viewing Mars about a month after its opposition at relatively low power (125x in the Sky 90 with a 2.5x Powermate, and 138x in the 10" reflector), I was not surprised to find low-contrast surface detail to be best with the 10mm TMB Super Monocentric. But it was almost as sharp and contrasty with the 10.5mm Pentax XL and 10mm Pentax XW. Despite repeated comparisons of the two Pentax eyepieces in different telescopes on different nights, I was unable to see a distinct difference between them in their on-axis resolution of planetary detail. They also seemed to have similar scatter on these bright objects, which I wasn't expecting due to the special partial coatings in the XW.

That was not the end of the surprises. The Pentax XL has a reputation for being “color-free" compared to other widefields, but I found some chromatic aberration in both eyepieces.

Atmospheric refraction is normal on objects near the horizon, but the Pentax XW seemed to show slightly more atmospheric refraction on such objects than the XL, perhaps because it has more lens elements. On bright objects high in the sky, both the XL and the XW showed no color on axis.

The color problem returned when viewing objects off-axis, however. When bright objects high in the sky were moved towards the edge of the field of view, they started to develop a chromatic blur. In line with the artificial star test, the problem started closer to the axis for the XW than the XL and was overall noticeably greater in magnitude. It was also subjectively more severe to my eye in the XW because the colors were more objectionable. By about 75 percent of the way to the edge of the field, Mars in the XW had a red edge toward the axis and a greenish blue edge away from the axis. The XL had a less objectionable purple edge toward the axis and bluish green edge away from the axis.

I found this chromatic effect in all three well-collimated test telescopes: the two reflectors at f5.0 and

f5.6 and the Sky 90 with extender-Q at f8.9 and with a 2.5x TeleVue Powermate at f13.9. The problem was less severe at slower f-ratios, but still evident. Just to have other eyepieces for reference, the same problem at about the same magnitude as the XW was seen with the 10mm Radian. The problem was not seen in the 10mm TMB Super Mono with its narrow AFOV.

All that being said, please note that I would consider the above effect to be in substantial part due to the telescopes used for the test. The XW had chromatic problems on bright objects viewed off-axis in two moderately fast reflectors. Would this improve with a TeleVue Paracorr or similar coma corrector? Probably so. As for the Sky 90 refractor, it's somewhat notorious for having more chromatic aberration than any apo has a right to have, and the extender-Q and Powermate improve but don't eliminate it. I would speculate that the 10mm XW's off-axis chromatic problem would be significantly less in telescopes with excellent color correction (reflectors and apo refractors) of f7 and slower, and slow f-ratio scopes such as SCTs and Maksutovs.

Test #4: Star clusters

With dim stars, the chromatic problem noticed with bright planets wasn't a problem. M13 was brighter in both Pentaxes than the 10mm Radian. I found it easier to resolve stars across the entire globular with the Pentaxes, and they gave a more satisfying image. Also, the elongation noticed in the artificial star test was not important for dimmer stars, which appeared to be pinpoints to the edge.

The double cluster was also fine in all three eyepieces. But again, a surprise. There was a subtle but noticeable difference between the Pentaxes: the background sky was darker with the XW than the XL. There appeared to be a faint blue haze across the field in the XL. This may be a function of the special “partial coatings" in the XW. I would doubt that it had much to do with the slight difference in power, since the haze was a bluish color. Obviously, it is also an effect that would make a difference in the XW performance on other objects as well.

Test #5: Dim fuzzies

On viewing dim fuzzies, I have a confession to make. I used to own 14mm, 21mm and 28mm Pentax XL's, and I gave them up when it seemed to me that they didn't have as much contrast on nebulae and galaxies as my 31mm Nagler T5, 17mm Nagler T4 and 12.5mm Zeiss Docter Donahue (thanks, Joe, for making a great custom housing for the Zeiss Docter!). So this was an opportunity for me to take another look at the performance of the Pentaxes.

Using the 10" and 20" reflectors, M57 (the Ring nebula), M8 (the Lagoon nebula) and M17 (the Swan nebula) were all bright and crisp in the Pentaxes. The 10mm Radian, though not giving as bright an image overall, had very satisfying contrast and I would put it in a tie with the Pentax XW. But the XL was as I had remembered it from several years ago, not quite as good as the TeleVue product or the XW. The darker background of the XW was also an improvement over the XL.

Test #6: Double stars

On this test it was also obvious that the XW had a darker background. But this wasn't necessarily helpful in making the split. The double-double split at 80 power in the Sky 90, and there appeared to be no difference between the XL and the XW. Star images were crisp in both Pentax products. The faint companion of Polaris was also easily visible with direct vision in both. Scatter from moderately bright stars was noticeable, but similar in both of the Pentaxes. This is again somewhat surprising, since I was expecting less scatter with the partial coatings of the XW.

Some thoughts about the problems

The XW's chromatic aberration is only evident with very bright compact objects (planets and very bright stars) viewed off-axis. This may be a problem if you plan to use it as a planetary eyepiece in an undriven dobsonian and need an excellent image across nearly the entire field. That is, after all, one of the primary reasons for owning widefield eyepieces. However, this may not be much of a problem for you if you have a driven equatorially mounted telescope, other eyepieces for planetary viewing, a Paracorr, a slower f-ratio, or spend most of your time viewing less-bright objects such as star clusters and nebulae.

However, the XW has an advantage over the XL in not putting a faint bluish haze over the field. This is likely to be most helpful with objects that are dim and need every advantage to stand out from the background. For viewing extended and compact nebulae with and without structure, star fields, and open clusters, my impression is that the XW would be the eyepiece of choice over the XL. I call it a draw between them when the objects don't benefit quite as much from the darkest possible background, such as globular clusters.

Although the Radian generally gave a dimmer image with slightly less contrast than the Pentaxes, I am mindful that my all-time favorite view of a globular cluster was seen through a 14mm Radian. For certain objects such as clusters and star fields seen under a dark sky or through a telescope large enough so that the loss of a few photons doesn't matter, it gives very fine images indeed. The Radian's background is as dark or darker than the XW, and it has good contrast on nebulae and galaxies.

Conclusion

This is a comparison of two fine 10mm eyepieces, not a test of the entire XW series. As is clear with other eyepiece sets (Radians, Widescan IIIs, etc.) some focal lengths have different characteristics than others, so you can't assume that all XW's will perform like the 10mm. In particular, the 2" XW's at 30mm and 40mm may have quite different characteristics than the 1.25" eyepieces.

In the chart below, five stars is the highest rating. Some categories are likely to be more important to you than others. And as the saying goes, your mileage may vary.

Object	***10mm*** ***Pentax XW***	***10.5mm*** ***Pentax XL***
Moon (high contrast surface features)	***** Excellent contrast and detail.	***** Similar to XW.
Planets (bright object, low contrast surface features)	*** Very good contrast/detail, but slightly more chromatic aberration off axis.	**** Similar to XW, with less chromatic aberration.
Double stars	**** Very good splits and star images.	**** Similar to XW.
Planetary or detailed nebulae or galaxies	***** Bright, good definition, dark background.	**** Similar to XW, slightly brighter background.
Diffuse extended nebulae or galaxies	***** Bright, stands out well, dark background.	**** Similar to XW, slightly brighter background.
Compact or globular clusters	***** Bright, great resolution.	***** Similar to XW.
Open clusters or star fields	***** Bright, great resolution, dark background.	**** Similar to XW but slightly brighter background.
General widefield experience	***** Wider field (70 degrees).	**** Narrower field (65 degrees).

The XW eyepiece clearly wins over the XL in apparent field of view. It also has a darker background which helps it do a better job with nebulae and open clusters; the special “partial coatings" apparently give a greater advantage on dim objects than on bright ones. Take a point off because of greater off-axis chromatic aberration on bright objects such as planets (although as already noted, on this factor the match between eyepiece and telescope becomes very important; take my results with a grain of salt).

If I had a set of Pentax XL's and liked their AFOV, I wouldn't be running out to replace them immediately. However, in subjective enjoyment of widefield objects, the XW has achieved its goal of improving the viewing experience. If you're considering a widefield eyepiece in the 10mm focal range, you can expect the Pentax XW to live up to the very high standard set by the XL.

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