$99 Meade and Celestron Eyepiece Set Comparo

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For over two years, telescope manufacturing giants Meade and Celestron offered a set of eyepieces for $99 with the purchase of many of their telescopes. Many of us buying a Meade or Celestron telescope gleefully plunked down the extra $99 and then immediately turned around and resold the eyepieces for a profit on Astromart. But I got to wondering: should we have kept them? Just how good are they?

Meade considers its eyepiece set to be worth over $600. Indeed, the 4-element Meade Series 4000 Super Plossls have long been considered one of the standard eyepieces, and have been reviewed many times over the years. (The Meades are on the left in the picture.) Celestron was somewhat vague about the value of its set of plossls, but the same set is now advertised for $149. Both included an attractive aluminum eyepiece case. The Celestron set also included a set of colored and neutral filters, and a “shorty” barlow. Unfortunately, as I write this, both manufacturers’ $99 eyepiece deal is over. Even so, many of these sets are available used, as are the individual eyepieces.

This review examines and compares the two sets. I have no connection with either manufacturer, although my wife owns a Meade telescope and I have other Meade eyepieces. The Meade set was purchased by Cloudy Nights, and the Celestron eyepieces were generously loaned to us for this review by Digitec Optical.

What Is An Eyepiece “Set”?

Interestingly, although both manufacturers seem to proceed virtually in lockstep regarding many of the features of their telescopes and mounts, they have rather different philosophies when putting together a set of eyepieces. In the chart below, you can see that the sets cover a different range of focal lengths with different intervals between those focal lengths.

Meade Series 4000® Super Plossls	***Celestron Plossls***
40mm	-
32mm	32mm
26mm (included with telescope, not tested)	-
20mm	-
15mm	15mm
12.4mm	-
9.7mm	9mm
6.4mm	6mm
-	4mm

To my mind, there is too little difference between focal lengths in the Meade set to buy all of them, if one had the choice to do so. Percentagewise, the differences between them range from as little as 17% between the 12.4 and 15mm and 19% between the 32 and 26mm down to a 34% difference between the two highest power eyepieces. The latter seems strange, since usually the highest powers are closest in ratio to give the greatest flexibility for planetary viewing. On the other hand, if one were picking and choosing which eyepieces to buy, the flexibility overall is excellent. Either set of the 40, 26, 15, 9.7, 6.4mm or the 32, 20, 12.4, 9.7, 6.4mm would be a fine choice, depending on the focal length of your telescope and the powers you want to view at.

So perhaps one option with the complete $99 Meade set would be to recoup your cost by selling just two or three of the eyepieces! You could do this because the retail value of the Meades is $79.95 for most of the series, and $99.95 for the 32 and 40mm versions. Used, they go for $30 to $70 or so. There is also a 56mm Super Plossl with a 2” barrel for $199.00, which I did not review and is not included in the special offer.

As for the Celestrons, their focal lengths make more sense to me. After the jump from 32mm to 15mm, the approximately 1/3 reduction in focal length for adjacent eyepieces over the rest of the set seems about right. The 2x Celestron barlow then conveniently gives an intermediate focal length between each eyepiece. The barlow is not advisable on the 32mm, since it would vignette (or narrow) the field of view.

The Celestron plossls look virtually identical to a low-cost generic set of plossls offered by a variety of manufacturers. They are made in Taiwan. They are not listed on the Celestron website, but an ad in the May, 2004 *Astronomy* magazine indicates that the entire set with filters, barlow and case is available for $149. So with the Meades at four

times the retail price of the Celestrons, this is somewhat of an apples-to-oranges comparison. The Meades should easily be better, right? Well, let's see…

The test gear and the objects tested

The eyepieces were tested in two telescopes over a modest range of focal lengths and f-ratios.

	Focal length	***f-ratio***
Takahashi Sky 90, 90mm apochromatic refractor with 1.6x Extender-Q	800mm	8.9
10" dobsonian, optics by Mike Spooner	1380mm	5.6

I used an artificial star to examine sharpness and coma across the field. The moon provided a view of high contrast surface features and sharpness.

Jupiter, Saturn and Venus were the most available planets. The first two provided a test for resolving low-contrast surface features, with Saturn's Cassini division a test for image sharpness. Venus was used to test scatter from a bright object across the visual field.

M37, an open cluster in Auriga, was used to examine resolution of dim stars. M42, the Orion nebula, was used to see if the eyepieces could resolve dim stars and reveal extended nebulosity.

But before going outside, I sat back and took a look at them indoors.

At the dining room table

Both eyepiece sets come in aluminum cases for storage and transport. The Celestron case (4.75" x 11" x 12.5") is smaller than the Meade (5" x 11" x 15.5"), and also has holes cut in the foam to accommodate each eyepiece in an upright position. The Meade case has long slots in the foam to hold the eyepieces sideways, which uses space inefficiently and makes them a bit harder to keep track of. The Celestron case seemed handier since it was smaller and easier to use and the eyepieces were upright and easy to identify.

The Meades come in translucent white plastic bolt cases that keep them safe from bangs and scrapes. However, the bolt cases also make them impossible to identify unless you use a label or a marking pen to put the focal length of the eyepiece on the side of the bolt case. The Celestrons have more conventional top and bottom eyepiece caps, which allowed an easy view of the focal length printed on the eyepiece yet were also easy to take off and put back on. Although there are many fans of bolt cases, I preferred the Celestron's approach to eyepiece protection.

As for the eyepieces themselves, at first look, both brands seemed to be of good quality, with no obvious flaws in external fit and finish. Both had fold-down rubber eye guards. As you can see in the picture, the design of the Celestrons was more varied – and more interesting, to my eye. The yellow lettering on the Meades was as easy to see under a red light as the white letters on the Celestrons, but the Meade lettering was smaller and harder to read when trying to identify focal lengths (especially for those of us with impaired reading vision who take off our glasses while viewing).

At second look, however, design flaws became apparent. Looking through the Meade 40 and 32mm eyepieces, my eagle-eyed friend Steve noticed that you can see reflections from light off the threads at the end of the eyepiece barrel. This would likely cause scatter when viewing very bright objects or when a bright object was just out of the field of view. The reflections were not there at the other Meade focal lengths or with any of the Celestrons.

Meades are advertised as “multicoated,” which usually means that at least some of the surfaces have multi-layer antireflection coatings. (In the careful lingo of advertising, “fully multicoated” or “FMC” usually means that *all* the lens surfaces are multicoated.) A simple test of coatings is to hold the eyepieces near a very bright light and see whether there are extremely bright reflections, which would indicate that a lens surface has not been given an antireflection coating. The result is more scatter, increased internal reflections from bright objects, and dimmer views due to less light throughput. Unfortunately, the 32mm , 20mm, and 15mm Meade eyepieces (the 26mm was not part of the test set) had such bright reflections. Lenses in the shorter focal lengths and the 40mm eyepiece all seemed to be adequately coated.

Otherwise, the Meades all had well-defined field stops and the edge of field could be comfortably viewed – although rolling down the rubber eyeguard made it much easier to view the edge of field with the 9.7mm and 6.4mm eyepieces since the eye relief is fairly short. The Meades are advertised as having a 52-degree apparent field of view (AFOV), and indeed it was noticeably wider than the AFOV of the Celestron eyepieces except at the 32mm focal lengths, where they were quite close.

As you can see from the picture (supplied to me by Hands on Optics), the Meades might have been made in (choose one): Japan, Taiwan, or China. The manufacturing site was not mentioned on the eyepiece, and the boxes were not included in the discounted set. I would bet that the versions in the discounted set were made by a less expensive manufacturer (probably not Japan).

As for the Celestrons, the 15mm and 6mm had a unique problem that to me indicated a serious design or manufacturing flaw: they had no field stop at all. That meant that the image simply blurred into black instead of having a nice sharp border around it. I have read about this problem in other reviewers' reports on these eyepieces, so it was not unique to these samples. This would not necessarily be a terrible thing, except that the blurred edge was actually narrower than the image in the Celestron eyepieces with a field stop.

The short focal length Celestrons also benefited from rolling down the rubber eyeguard due to short eye relief, especially the 6mm and 4mm. People have varying degrees of discomfort with short eye relief, but I tend to not mind it as long as it doesn't result in fogging up the eye lens. Also, the 6mm eyepiece in this set had some slight asymmetry in the field lens (thanks again, Steve, for your sharp eyes!).

The Celestron eyepieces are also labeled "multicoated." Unfortunately, due to a major mental lapse on my part, I did not use a bright light to examine whether the Celestrons had any uncoated surfaces prior to sending them back to the most generous donor who loaned them to Cloudy Nights for this review. My apologies. If anyone with these eyepieces would care to examine them near a bright light to see if there are bright reflections, I would be pleased to update this observation and give credit to the observer.

The Celestron set also came with filters and a barlow lens. I am not a "filter guy," so I did not use the filters during viewing sessions. I did note that they had bright reflections off their surfaces, so you would likely have additional scatter and loss of light when using them. They also easily screwed on and off the ends of the eyepieces. As for the barlow, it appeared to be well-constructed and held the eyepieces securely, with minimal wobble.

Test #1: The artificial star

Some months ago, I built an artificial star so I would have a more consistent way of comparing eyepieces. The Sky 90 at f8.9 was set up with focal length extenders for straight through viewing of the artificial star about 35 feet away, and easily brought the star into focus with all the test eyepieces.

The two basic tests consisted of looking at the focused airy disk and the two-diffraction-rings-unfocused image of the artificial star at different points (on-axis, and 50%, 75%, and 90% off-axis) across the entire field of the eyepiece. With the airy disk in focus, I was looking for coma or loss of focus, and with the unfocused diffraction rings I was looking for distortions in the rings as another sign of optical problems such as astigmatism. My experience is that the artificial star is highly sensitive at detecting distortions in the field of view, and that these distortions almost always are relevant to how well the eyepiece performs in the field. You should note, however, that using other observing equipment may make them more obvious or less obvious than how I saw them.

The number in the chart indicates relative amount of distortion at each part of the visual field. The numbers roughly indicate by what multiple of its apparent diameter the

artificial star image is distorted. Zero is good (the image is perfectly round), large numbers are bad (the image is elongated and distorted). A number "4" or higher is usually associated with an essentially unusable image when the eyepiece is being used out in the field. All images were undistorted ("0") on-axis.

Focal length (mm) and brand	***50% off-axis***	***75% off-axis***	***90% off-axis***
Meade 40	0.5	2	4
Meade 32	0.5	1	6
Celestron 32	**1**	**2**	**6**
Meade 20	0.5	2	6
Meade 15	0.5	2	6
Celestron 15	**0.5**	**3**	**8**
Meade 12.4	0	1	4
Meade 9.7	0	1	2
Celestron 9	**0**	**3**	**6**
Meade 6.4	0	0.5	2
Celestron 6	**0**	**0.5**	**2**
Celestron 4	**0**	**0.5**	**2**

All the eyepieces gave a pretty good image in the central part of the field of view, with images up to 75% off-axis likely to be tolerable in all the eyepieces. The 40mm Meade was a good performer at the very edge of the field, although it had only about a 42-degree AFOV. Going more than 50% off-axis, the images in the mid-range Meades (from 20mm to 9.7mm) were generally less distorted than those in the 15mm and 9mm Celestrons. The Celestron 32mm was slightly less sharp at 50% and 75% off-axis than the Meade. Both brands performed well at the 6mm/6.4mm focal lengths, and the Celestron performed well at 4mm. However, at the two readings farthest off-axis, all the Celestrons showed slightly more chromatic aberration than the Meades with the Sky 90.

I also tested the Celestron 6mm and 4mm with the included barlow lens. The barlow tended to "bloat" the image of the artificial star and added a objectionable amount of chromatic aberration at any off-axis position of the image. I would not recommend using the barlow for serious viewing.

Test #2: The moon

The long focal length Meades, particularly the 32mm, had a great deal of scatter surrounding the moon. In fact, it would be hard to say that the sky was black near the moon – it was more of a dark hazy green. By comparison, the 32mm Celestron gave a much blacker sky around the moon and a sharper, more contrasty view on-axis. However, as the artificial star test foresaw, the view off-axis in the Celestron was not quite as sharp as the 32mm Meade.

The Meade 20mm and 15mm eyepieces (remember the uncoated lens surfaces in these eyepieces) had slightly less scatter than the longer focal lengths, and were sharper at the edge of field than the Celestron 15mm. However, despite the 15mm Celestron's lack of a field stop, it continued to have better contrast than the Meades in the center part of the field. The Meade 15mm also gave had a slight greenish tinge to the edge of the moon.

The Meade 12.4mm, 9.7mm and 6.4mm had significantly less problem with scatter. However, the image at the edge of the 9.7mm was out of focus when it was in focus on-axis. The 6.4mm was better at keeping the edge and center in focus together. The Celestron 9mm was better than I'd expected from the artificial star, and gave a view at least as pleasing as the Meade. Despite similar performance on the artificial star, the Celestron 6mm could not keep the center and edge in focus together as well as the Meade 6.4, although the Celestron 4mm did a good job of this.

The moon was the only object I looked at with all the eyepieces in the test. The other objects were examined only with the eyepieces that obtained the best views or that helped answer a particular question.

Test #3: Venus, Jupiter and Saturn

Venus, as a very bright object, was another good test of scatter. The Celestron 32mm continued to perform better than the Meade 32 at giving a darker, more pleasing background sky. This also paid off in detecting faint stars. Two faint stars near Venus were easily seen with direct vision through the Celestron, and were invisible through the Meade even with indirect vision, which again confirmed for me the likelihood that the 32mm Meade had uncoated surfaces significantly impairing light throughput. However, the 32mm Celestron again had more chromatic aberration at the very edge than the Meade. The 6mm Celestron and 6.4mm Meade were much closer in performance with regard to scatter on Venus.

On Jupiter and Saturn, the 9mm Celestron and 9.7mm Meade were also very close in performance. The Meade had slightly more scatter and a brighter background, but not significantly so. The 6.4 Meade seemed to give a slightly sharper view of Saturn than the 6mm Celestron, but the excellent contrast of the 6mm Celestron reversed the order of on-axis performance on Jupiter, although it was still a close call. Remembering, however, that the 6mm Celestron had a narrow field of view and no field stop, it was harder to use with an undriven mount since the telescope had to be adjusted more frequently. The 4mm Celestron was not bad at all, and gave a somewhat better view of the gas giants than the 6mm.

Test #4: M37 and M42

M37 is a very pleasant, relatively bright open cluster in Auriga that was framed well with a 15mm eyepiece. The 15mm Celestron, notwithstanding its edge problems, showed crisper stars against a darker background than the Meade.

M42, the Orion nebula, got a closer look. The 32mm eyepieces gave fairly similar images. Scatter wasn't as big an issue, since M42 is less bright than a planet or the moon. However, the 32mm Meade still had a slightly brighter background and had less contrast than the Celestron, but had sharper stars at the edge of the field of view. At 15mm, the Celestron again had better contrast than the Meade, making it possible to see slightly more nebulosity. Fainter stars in the center of the field were also crisper and easier to see.

The 40mm Meade was a mixed performer and not the best choice for this object. I had to move back from the eyeguard to see all the field of view since the image tended to blackout with my eye closer to the eyepiece. The background sky was lighter even than the 32mm Meade, in part due to the longer focal length. Consequently, almost no nebulosity in M42 was visible.

Miscellaneous observations

The Meade 32mm and 40mm eyepieces and the Celestron 32mm were recruited as "finder" eyepieces with both of the telescopes used in the test. Surprisingly, I found the Meade 40mm to be the least useful, since the actual field of view was identical to that of the 32mm eyepieces and the lower power gave a brighter background and made it more difficult to see dim objects. The 32mm Celestron beat out the 32mm Meade for this purpose because of its better contrast, making dim objects brighter and easier to see.

Conclusion

I expected the Meade Series 4000 Super Plossls to handily beat the Celestron plossls that retailed for only a quarter of their price. It didn't work out that way. Both sets of eyepieces had their advantages and disadvantages, as noted in the chart below. Five stars is the highest rating in each category.

Focal length (mm) and brand	***Moon***	***Planets***	***Deep sky objects***
Meade 40	**	-	**
Meade 32	**	**	***
Celestron 32	****	****	****
Meade 20	***	-	-
Meade 15	***	-	***
Celestron 15	***	-	****
Meade 12.4	***	-	-
Meade 9.7	****	***	-
Celestron 9	****	****	-
Meade 6.4	****	****	-
Celestron 6	***	****	-
Celestron 4	****	****	-

The long focal length Meades lost out to the Celestrons on bright objects and deep sky objects due to their high level of scatter and the 32mm Celestron's superior contrast. At shorter focal lengths, however, the Meade lens coatings were apparently better and the scatter problem became less critical. For high power planetary viewing, the two shortest focal length Meades did a nice job and the 4mm Celestron was also a surprisingly good performer.

If I were assembling a set out of all the test eyepieces, I would choose the Celestron 32mm for low powers. In the midrange it was more of a toss-up, with both 15mm eyepieces having their advantages and disadvantages and the Meade 12.5mm being better than the Meade 20mm. The Meade 9.7mm, 6.4mm, and Celestron 4mm would be my choices for high power viewing. If I had to choose a single set, my interest in deep sky objects would tilt me toward the Celestron plossls. Someone with a preference for planetary viewing might easily choose the Meades.

I would not be surprised if a reader with a Japanese-made set of Meade Series 4000 Super Plossls wrote back to me and said, "Scatter? What scatter?" Indeed, I have three of the Japanese-made Meade Series 4000 Ultra Wide Angle eyepieces. They give very dark backgrounds with little scatter and despite their minimal eye relief are my favorite short focal length wide angle eyepieces.

In sum, I would say that if the coatings had been better on the Meade Super Plossls, they would have won the comparo handily, being sharper at the edge and having a wider field of view. As it was, however, the Celestrons more than held their own, and had the advantage at several focal lengths. If you are buying these eyepieces at retail, however, you would do well to make a more apples-to-apples comparison in terms of price, putting the Meade Super Plossls up against the Celestron Ultimas, which in my experience are both sharp at the edge of the field and have excellent contrast.

Both the Meade and Celestron eyepiece sets are designed for general viewing of all types of objects and can be satisfying for more than just beginning observers. There are good eyepieces in both sets as well as eyepieces to avoid, but the better eyepieces will provide you with ample enjoyment of the sky.

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