The following is a basic guide to some of the factors to take into consideration when choosing eyepieces. It is based on my experience but also on conversations with and articles by other observers much more qualified than myself.

Eyepieces Terms

The choice of which eyepieces to purchase is almost as important as which telescope and
eyepieces couple to our telescopes to give us our observing experiences and a bad choice of eyepieces will limit the experience as much as a bad choice of telescope. The best advice I can give to anyone contemplating a purchase of an eyepiece is to research it, read reviews of it and speak to people using one, go to an observing evening and try it out because an eyepiece will perform differently in each scope. The following is a list of terms used in relation to eyepieces and why they are used in eyepiece evaluation.

**Focal Length**

All eyepieces have a stated focal length in the same way as all telescopes have a stated focal length; focal length is the effective distance from the entrance of the eyepiece to its focal point. Focal length is important because the telescope focal length divided by the eyepiece focal length will give you magnification, all eyepieces will have the focal length imprinted on the eyepiece.

**Field Stop**

The field stop is a ring inside the barrel of an eyepiece that defines the edge of the field of view. In most eyepieces the field stop is not the inside of the barrel but a designer introduced ring inside the barrel, this is introduced to sharply delineate the edge of field of view and to prevent a gradual drop off in quality of view. In some reviews, the reviewers will state that the field stop is not properly placed; this usually means that the edge of the field of view is ‘mushy’ which detracts from the viewing pleasure. The field stop limits the Apparent Field of View (AFOV) and True Field of View (TFOV) of an eyepiece.

**Eye Relief**

Eye relief is the distance above the eyepiece we place our eye to see the entire field of view of the eyepiece. Eye relief affects our comfort when we observe, if the eye relief is too small our eye is too close to the lens, indeed in some eyepieces the relief is so short that, if we blink, our eyelashes touch the lens. If you are a spectacle wearer and need to observe with the glasses on you will probably need 18mm or more of eye relief, however if you remove your glasses or do not need glasses 8mm is enough eye relief to be comfortable. Too much eye relief can be as frustrating as too little as it makes the ideal placement of your eye difficult and you can feel disconnected from the eyepiece, extended eye cups can remove this problem.

**Apparent Field Of View (AFOV)**
The apparent field of view is the field of view advertised by eyepiece suppliers. It’s the angle your eye sweeps out when you look at one edge of the field in the eyepiece and then look to the opposite edge. The greater the AFOV the more of the sky you will see, many of today’s most highly regarded eyepieces are ones with a large AFOV, this is because it gives a more immersive feeling to the observer. With a larger field of view it also enables higher magnification to be used and still encompass quite large objects, the picture belows show two views at the same magnification, the one on the left has a 50° AFOV the one on the right an 80° AFOV, as can be clearly seen the one on the right frames the subject better.
The Exit Pupil is the size of the image formed from the eyepiece, it is very closely tied in with magnification in that higher magnifications give smaller exit pupils and lower magnifications give larger exit pupils. Exit pupil is worked out by dividing the eyepiece focal length by the focal ratio of the telescope being used.

Exit pupil is a factor in choosing eyepieces because of the limitations of the Human eye, at best the human eye dilates to 7mm so an exit pupil greater than 7mm means you are not seeing the whole image i.e. you are not utilising the full aperture of the telescope. If you are using a refractor this is the only reason not to use an exit pupil greater than 7mm, however, if you use a reflector there is another reason not to use a larger exit pupil than 7mm. All reflectors have a secondary mirror which forms a shadow on the primary mirror, we usually talk about this central obstruction as a percentage of aperture and the obstruction is always in the centre of the image, normally this is not noticeable but if the exit pupil is increased so is the effect of the central obstruction until it can become apparent as a black spot in the centre of the image. To find the longest focal length eyepiece to use multiply your focal ratio by 7 and this will give you the eyepiece focal length which will produce a 7mm exit pupil. The minimum exit pupil will be decided by our eye, for even the best sighted person an exit pupil of less than 0.5mm will reveal defects in the eye such as ‘floaters’.

Eyepieces Issues

When choosing eyepieces it is also important to be able to understand what issues may be prevalent in the eyepiece design. If you are researching which eyepieces to purchase you will sometimes read about defects or aberrations in a certain eyepiece, often the reviewer will state what problem they found e.g. “there is rectilinear distortion present”, this is only useful if you know what rectilinear distortion is and how it effects the view through an eyepiece. The following is a list of the more common defects/aberrations that effect eyepieces and a short explanation of what might be seen through the eyepiece if they are present.

Rectilinear Distortion

As this is mentioned above I will start with it. When there is rectilinear distortion present reviewers quite often write of the ‘fishbowl effect’, the picture below illustrates the issue.
observing experiences, when contemplating an eyepiece it is very important to consider the and trying out various eyepieces will enable you to make good choices for your eyepieces. in this I definitely speak from bitter experience. Reading reviews, speaking to fellow observers
Choosing the correct eyepiece or selection of eyepieces is very important to maximising your There are other terms often used in reviews to describe flaws in eyepieces but in most cases the field of view where a bright star, planet or the moon would have a false colour fringe. Chromatic aberration is caused because no lens no matter how well configured or made can severely effect by CA but if an eyepiece suffers from CA it will be noticed, usually, at the edge of focus all colours of light at exactly same point. It is not that common for an eyepiece to be Chromatic Aberration view towards the edges. Vignetting is caused when a lens of an eyepiece is not able to field all the lights rays coming Vignetting annoying defect in an eyepiece as it results in a black spot or kidney bean floating around the view. Spherical Aberration of the Exit Pupil most observers will never know if it exists in an eyepiece. The only real impact is if an observer is carrying out star drift timings, i.e. timing a star moving across the field of view in an undriven scope, then the timings will be slightly off as the speed with which the star moves across is not constant (it will move faster across the centre than at the edges). Angular Magnification Distortion is where the degree of magnification differs slightly from the of the field are usually like crosses or some say they look like bats at the edge of the field. Astigmatism is quite often present in inexpensive eyepieces, especially if they have a larger curvature of eyepiece field being different form the horizontal curvature of the field. Astigmatism is widely regarded as the most 'annoying' aberration to be present in an eyepiece become. Astigmatism Field curvature is recognised by stars at the edge of field being out of focus, slightly blurred focus the stars at the edge of the field by either out-focusing (then the curvature is concave) or does not mean that in your set-up you will experience a similar issue. Field curvature is not purely a result of the eyepiece but as a result of the counteract the convex plane of the scope resulting in a perfect flat field. Our eyes can of our eyes to accommodate for field curvature lessens with age so older observers are bother by in-focusing (then the curvature is convex) but of course the central stars will now be out of focus. As I stated field curvature is not constant with every telescope, an eyepiece may present field curvature in one scope but not in another, this is because all telescopes and eyepieces have a slightly curved focal plane (in scopes it is usually convex but in eyepieces it can be either convex or concave). It is the interaction between the two focal planes that can cause field curvature to be compensated for a degree of field curvature so we will not notice slight field curvatures (the ability more by this than the younger observers).

### A Short Guide to Choosing Eyepieces by Neil Paterson

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<td>#25 Red</td>
<td>Useful in twilight or daylight to reduce the brightness of the sky</td>
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#15 Deep Yellow Useful for observing the Martian Polar caps

#21 Orange Useful in observing the Maria

#23A Light Red Useful in observing the Maria

#25 Red Useful in observing the Maria

#56 Light Green Useful in observing the polar caps

#58 Green Useful in observing the polar caps (especially in larger scopes)

Jupiter #12 Yellow Useful for observing the red and orange features

#21 Orange Useful for sharpening contrast on the belts and Great Red Spot

#80A Blue Useful for overall observing of Jupiter helps with contrast in cloud belts and in belts and in

#82A Light Blue Useful for enhancing the low contrast features

Saturn #12 Yellow Useful for observing the red and orange features of belts and zones

#21 Orange Useful for observing the polar regions

#23A Light Red Useful for observing the polar regions

#47 Violet Can be some help in observing the rings in larger scopes

#80A Blue Useful for enhancing detail in belts and polar regions

Uranus #8 Light Yellow Can be useful in improving detail but needs a large scope

Neptune #8 Light Yellow Can be useful in improving detail but needs a large scope