Considerations in Choosing Binoculars

The brilliance and sharpness of the image you see through a particular binocular or spotting scope is determined by a number of different factors, including the interaction of these factors. Magnification, optical coatings and lens diameter are just a few of the factors influencing how a binocular performs.

However, the single most important criterion in performance will always be the quality of the optics. Celestron delivers optical excellence through careful consideration of quality in the glass and lens coatings used, precision manufacturing processes, and uncompromising quality control.

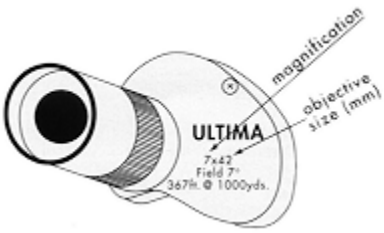
Please consider the following factors when choosing a Celestron binocular.

Magnification (Power)

Magnification is the degree to which the object being viewed is enlarged. For example, with a 7x42 binocular, the number 7 represents the "binocular power". A binocular of the power 7 magnifies an image to seven times the size it would be when viewed by the normal, unaided human eye. The level of power affects the brightness of an image, so the lower the power of a binocular, the brighter the image it delivers will be. In general, increasing power will reduce both field of view and eye relief, which are also discussed here.


1x
(unaided eye)

Magnification Comparison Chart



Diameter

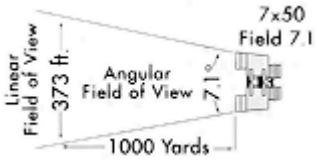
The objective lenses of binoculars are the front lenses. The diameter of one of these lenses, given in millimeters, will be the second number describing a particular binocular. Hence, a 7x42 binocular has an objective lens of 42mm. The diameter of the lens determines the light gathering ability of the instrument, with the greater light gathering ability of a larger lens translating into greater detail and image clarity. This is especially useful in low light conditions and at night.

Doubling the size of the objective lenses quadruples the light gathering ability of the binocular. For instance, a 7x50 binocular has almost twice the light gathering ability of a 7x35 binocular and four times the light gathering ability of a 7x25 binocular. This might lead you to assume that bigger is better when it comes to the diameter size of the objective lenses, but in reality the size of the lens must be considered along with exit pupil and intended usage to determine the best binocular for you.

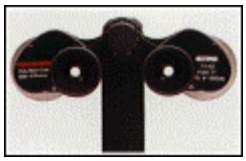
Field of View

The size of the area that can be seen while looking through a pair of binoculars is referred to as the field of view. The angular field of view is indicated on the outside of the binocular, in degrees. The linear field of view refers to the area that can be observed at 1,000 yards, and is expressed in feet. A larger field of view translates to a larger area seen through the binocular.

Field of view is related to magnification, with greater magnification creating a smaller field of view, in general. A large field of view is especially desirable in situations where the object viewed is likely to move, or when the user is moving.



You can use angular field to calculate the linear field by multiplying the angular field by 52.5. For example, if the angular field of a particular binocular is 8° then the linear field will be 420 feet, i.e. the product of 8 x 52.5.



Exit Pupil

The diameter, in millimeters, of the beam of light that leaves the eyepiece of a pair of binoculars is the "exit pupil". The larger the exit pupil, the brighter the image obtained will be. Having a large exit pupil is advantageous under low light conditions and at night. For astronomical applications, the exit pupil of the binocular should correspond with the amount of dilation of your eye's pupil after it has adapted to the dark. This number will be between 5mm and 9mm. 9mm of dilation is the maximum amount for the human eye, and this number tends to decrease with age.

To calculate the exit pupil, divide the size of the objective lens by the magnification of the binocular. For example, the exit pupil of 7x42 binoculars is 42 ÷ 7 = 6mm.

Eye Relief

This refers to the distance, in millimeters, that a binocular can be held from the eye and the full field of view can still be comfortably observed. Eyeglass wearers in particular benefit from longer eye relief.

Brightness

A binocular's ability to gather and transmit enough of the available light to give a sufficiently bright and sharp image defines its brightness. The brightness of a binocular also enhances color differentiation in the image observed. R.B.I. (Relative Brightness Index), Twilight Factor and R.L.E. (Relative Light Efficiency) are common indices used in the binocular industry, but are all somewhat flawed in their design and often prove fairly meaningless. Brightness is one criteria to be considered when purchasing binoculars, but is not the most important factor. Given in order of importance to the overall brightness of a binocular, the following factors are worth investigating: objective lens diameter, magnification, the type and quality of the objective lens glass, type of lens coatings and type of prisms used. In general, large objective lenses, low magnification and fully multicoated lenses are most desirable.

Resolution

A measurement of the binocular's ability to distinguish fine detail and produce a sharp image. Better resolution also delivers more intense color. Resolution varies in relation to the size of the binocular's objective lenses. Generally, a larger objective lens will deliver more detail to the eye than a smaller objective lens, regardless of the magnification of the binocular. Actual resolution is determined by the quality of the optical components, the type and quality of the optical coatings, atmospheric conditions, collimation (i.e. proper optical alignment), and the visual acuity of the user.

Contrast

Refers to the degree to which both dim and bright objects in the image can be differentiated from each other and from the background of the image. High contrast helps in observing fainter objects and in discerning subtle visual details. High quality optical coatings provide better contrast in an image. The other factors affecting contrast are: collimation, air turbulence, and objective lens, prism and eyepiece quality.

Near Focus

The distance between the binocular and the nearest object you can focus on, while maintaining a good image and sharp focus, defines the near focus of a binocular.

Lens Coatings

The optical elements of the binocular are coated to reduce internal light loss and glare, which in turn ensures even light transmission, resulting in greater image sharpness and contrast. Choosing a binocular with good lens coatings will

translate to greater satisfaction with the product you ultimately select. Lens coatings range in quality as follows: coated -- fully coated -- multicoated -- fully multicoated. Coated lenses are the lowest quality and basically will not result in a product that will satisfy you. Fully coated lenses are quite economical and can work well for you, depending on your needs. Multicoated or fully multicoated lenses are both very good choices. Fully multicoated lenses give the best light transmission and brightest images, and are therefore the most desirable.

Prisms

A binocular's prisms serve to invert the image and come in one of two basic designs: Roof or Porro prisms. By design, roof prisms are more lightweight and compact, for portability. Porro prisms are designated either BK-7 or BAK-4. Both are economical and highly effective designs. The finer glass in the BAK-4 design is of high density and virtually eliminates internal light scattering, producing sharp, well defined images.

Construction

A critical factor in the performance of any binocular is its construction. The security of the barrel alignment and proper internal mounting and alignment of the optics are crucial to producing a binocular that's mechanically reliable, smooth functioning and long-lasting.

Collimation

The alignment of the optical elements of the binocular to the mechanical axis. Good collimation prevents eyestrain, headaches, inferior and double images while improving resolution. Unfortunately, proper collimation is almost impossible to achieve in very low-priced binoculars that lack quality components and design.

As you see, there are a number of different factors to consider in choosing a binocular. Your Celestron dealer will be able to assist you in making the choice that's right for you and that will bring you years of viewing comfort and pleasure.