BINOCULARS

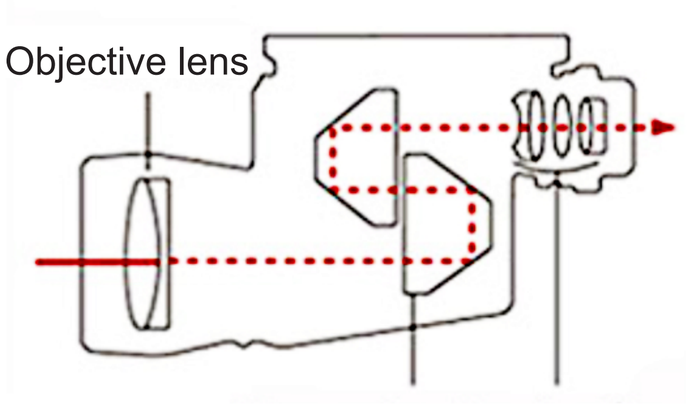
Binoculars are the second most important and versatile observational aid after the eye. They typically have a field of vision (FOV) of about 5° and magnifications that range from 7 to 10x, ranging up to 20x.

Binocular designs There are two dominant types of design, both of which use two prisms:

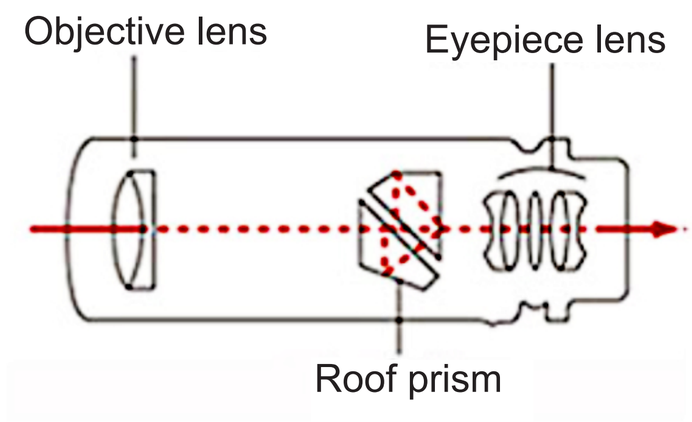
- The *Porro Prism* is a simpler design with a simpler light path that transmits light more efficiently and therefore gives greater contrast. The bulkier design enables the use of larger objective lenses, which collect more light. Porro prisms tend to dominate for everyday uses or astronomical observation.

- The *Roof Prism* is more compact, lighter and more comfortable to hold but it has a more complicated light path which requires greater optical precision. The more compact design requires smaller objective lenses with the result that less light is collected. Roof prisms dominate the high-end bird-watching market.

Porro Prism Binoculars



Roof Prism Binoculars



Binocular specifications
All binoculars specify the magnification (e.g., 8), objective lens diameter in mm (e.g., 8x40) and field of view in angular degrees (typically 5° to 7.5°) or a linear measure of how many feet can be seen at 1,000 yards (263' to 393'). To convert angular degrees to feet/1000 yds, multiply by 52.5.

Binocular glass
The prisms in binoculars are manufactured from ordinary crown glass (BK-7) or from superior Barium crown glass (BAK-4), which has lower light dispersion but is more expensive. You can easily distinguish between the two kinds of glasses by holding the reversed binoculars at half arms-length and looking into the primary lenses. If the lenses have a greenish tinge with circular exit pupils, you are looking at BAK-4 glass. If the lenses have a reddish tinge with irregular or square exit pupils, you are looking at BK-7 optics.

Buying binoculars
The best bird-watching binoculars have Roof Prisms at 8 x 42. For star gazing, use binoculars mounted on a tripod with 10 x 50 or larger Porro prisms.

Milestones in binocular development

1608 Hans Lippershey makes the first binoculars from two Galilean lenses (convex + concave), which give a very narrow FOV.

1854 Ignazio Porro designs Porro Prism binoculars using prisms rather than lenses. They give wider separation of the reflecting prisms and better performance.

1897 The first Roof Prism binoculars (Penta 7 x 29) are designed by Carl Zeiss.

1917 Wide-angle binocular eyepieces are mass-produced for the first time.

1935 Anti-reflective coating increases light transmission by 50%.

1969 Pocket binoculars, which can be folded up and put into a pocket, are designed by Zeiss.

1990 20x60 binoculars with image stabilization are developed by Zeiss.

2004 Fluoride introduced into optical glass to reduce colour aberrations.

2012 Victory HT binoculars achieve >95% light transmission for the first-time using SCHOTT HT glass with Zeiss T* multi-layer coating.