



Optics Buyers Guide

The following guide contains important information for prospective binocular buyers to help them achieve a thorough understanding and gain detailed insight into the many different features and qualities of binocular components, their construction and lens coatings.

Binoculars by definition:

Binoculars, Binos, field glasses, glasses etc are all names for what is essentially a pair of identical telescopes, mounted side by side and precision aligned to point accurately in a direction defined by the user, allowing the viewer to use both eyes with *binocular* vision to view distant objects.

Prism Types:

Prisms are a glass element that is used to produce an upright, correct, left to right image in a binocular. There are two types of Prisms available, *Porro prisms* named after Italian optician Ignazio Porro who patented this image erecting system in 1854, and Roof prisms of which there are two types, the Abbe-Koenig prism and the Schmidt-Pechan, each named after their German creators.

Porro Prisms:

Porro prism binoculars can offer an increased performance at a higher cost, however this advantage is often lost in the field of hunting optics as their body is often larger, bulkier and wider than Roof prism models. The prisms are set in a Z shaped configuration to erect the image, resulting in a wide body with objective lenses that are well separated and offset from the eyepieces.

Roof Prisms:

Roof prism designs create an instrument that is ideally suited to hunting and field use where the binocular body is smaller, narrower, streamlined and more compact than Porro prisms. They have objective lenses that are in line with the eyepieces. Optically the sharpest roof prism binoculars are phase corrected and the brightest roof prisms will have silver coated mirrors.

Wedgetail Raptor Series are Roof prisms binoculars, they are phase corrected and feature silver coated mirrors.

Prism Material

There is different quality grades of optical glass used in manufacture of binocular prisms. Bak 7 is an inferior grade and is used in cheaper, inexpensive base models, and Bak 4 grade is the highest quality grade and is used in all quality binoculars.

All Wedgetail Binoculars and Spotting scopes feature Bak 4 prisms

Lens Material

Aspherical lenses

This quality lens type corrects the curvature aberration created around the perimeter of a field of view and results in an image with sharper field of view with minimal distortions.

ED lenses

Ed stands for "Extra Low Dispersion" lenses and they help eliminate "chromatic aberration" or colour fringing, therefore delivering *maximum* focal sharpness, clarity and colour correction. Additional benefits of ED glass include its complete resistance to temperature changes, and also its inherent hardness and scratch resistance; these qualities make it ideal for use on the front lenses of hunting binoculars that are often subjected to harsh conditions in the field.

Wedgetail Raptor Series binoculars feature Aspherical lenses, and ***Raptor Ed Series*** binoculars and ***Peregrine ED Spotting Scopes*** feature ED lenses

Optical Coatings

Lens coatings are chemical coatings on the lenses of binoculars to reduce the amount of light reflected or lost. Binoculars can have up to 18 air-to-glass surfaces, and when light strikes the surface of the lenses, some is transmitted and some is reflected. In an ideal situation no light would be reflected, unfortunately this is not possible, however the application of quality optical lens coatings greatly reduce reflection losses which results in a brighter and sharper image. Classic lens coating material is Magnesium fluoride which reduces reflections from 5% to 1%, however modern lens coatings consist of complex multi-layers that achieve reflections losses of 0.25% or less. The end result is binoculars that yield an image with maximum brightness, contrast, natural colour and clarity.

Marketing terms used to denote Optical Coatings

There are 5 main grades of optical coating quality, and the presence or lack of these coatings provides a true indication of the overall quality of the image provide by the binocular. In order of quality from least to highest, these coatings are typically defined by the following terms:

Coated Optics: (Minimal quality)

One or more surfaces are anti-reflective coated with a single-layer coating

Fully Coated:

All air-to-glass surfaces are anti-reflective coated with a single layer coating

Multi-Coated:

One or more surfaces have anti-reflective multi- layer coatings

Fully Multi-Coated: (Maximum quality)

All air-to-glass surfaces are anti reflective multi layer coated.

Phase coated:

The roof prism has a phase corrected coating to reduce the phase shift in polarized light paths which reduces contrast and resolution. Applicable only to Roof prism binoculars.

Roof prism Mirror Coatings

In roof prism binoculars some surfaces of the roof prism must be mirror coated for efficient reflection of internal light. As opposed to previous surface coatings of lenses where the aim is to reduce reflectivity and allow maximum light transmission into the binocular, in the case of roof prisms where internal light has to be reflected via the prism surfaces, high quality mirror coating must be used to achieve maximum reflectivity within the binocular.

Aluminium mirror coatings:

This is the default level of coating where the roof prism mirrors are coated with Aluminium and commonly achieve a reflectivity of between 87%-93%.

Silver coated:

Silver coating of the roof prisms is used in modern, high quality designs and commonly achieves a reflectivity of 95%-98%. It is crucial however in these designs that the binocular body is sealed and nitrogen purged to provide an inert atmosphere which ensures the silver coatings cannot tarnish.

Dielectric coatings:

A dielectric mirror coating is a high cost multi-multilayer non-metallic reflective coating and can provide a reflectivity of more than 99% across the visible spectrum of light.

*All **Wedgetail** Binoculars have Fully Multi-Coated & Phase Coated lenses & Silver Coated Roof prism mirrors.*

Optical Parameters

Binoculars are often designed for a specific application or purpose for which they are intended. The differing designs and applications create certain parameters which are often listed on the prism plate or focus wheel of the binocular. These parameters are:

Magnification:

The magnification of a Binocular is the first number out of 2, eg **8** x 42 with 8 being the magnification. A magnification factor of 8, for example produces an image as if one were 8 times closer to the object. Bigger is not always better, as a larger magnification leads to smaller field of view, reduced image brightness and reduced image steadiness. In general a 10x binocular is the highest magnification that can be comfortably steadied without an additional support, usually in the form of a tripod.

Objective Diameter:

The objective diameter of a binocular is the second number out of two eg 8 X **42**, with 42 being the objective diameter. This number directly affects performance. When magnification and quality is equal, the larger the objective diameter the brighter and sharper the image. An 8 x 42 will produce a sharper and brighter image than an 8x25, however increasing the objective diameter increases the weight, size and cost of a binocular.

Field of View:

The field of view of a pair of binoculars is the amount of territory that can be seen at a particular distance, and is determined by its optical design. It is usually noted in a linear value such as how many metres in width can be seen at 1000m distance. It can also be expressed in an angular value of how many degrees can be viewed.

Exit pupil:

Exit pupil is a very rough guide to image brightness, and binoculars with a large exit pupil generally provide brighter images under very low light conditions. The exit pupil in a binocular is measured in millimetres and is the actual width of the beam of light that leaves the eyepieces. The larger the objective diameter of a binocular (front lenses) the wider the beams of light (exit pupil) that leave the eyepieces. This makes it more comfortable to view with 8x42's than 8X25's. The exit pupil is calculated by dividing the magnification into the objective diameter (the first number into the second) so a 10X50, 7X35 & 8X40 all have an exit pupil of 5. The exit pupil can be seen by holding the binocular at arm's length and a small circle of light can be seen in each eyepiece-this is the exit pupil. For normal daylight viewing an exit pupil of 2.5-3 is standard, however in lower light conditions and astronomy applications 5-7mm is preferred. An exit pupil larger than 7 is wasted, as the human eye cannot open wide enough to accommodate an exit pupil larger than this. A word of caution though, the Exit pupil rating should not be taken too literally, as it treats all binoculars regardless of lens coating and optical quality as equal, and this is simply not the case amongst different brands and manufactures.

Relative brightness:

Relative brightness, much like exit pupil is a rough guide to image brightness. This value is simply the exit pupil squared, therefore a binocular with an exit pupil of 5mm has an RE of 25. As with Exit pupil, the relative brightness rating should not be taken too literally, as it treats all binoculars regardless of lens coating and optical quality as if they were equal, and this is simply not the case amongst different brands and manufactures.

Twilight Factor:

The twilight factor is purely a mathematical formula that predicts the amount of detail that can be seen in low light. Twilight factor is the square root of magnification times the objective. A 8x42 will have a twilight factor of 18.3. As with exit pupil and Relative brightness the twilight factor should not be taken too literally, as it treats all binoculars regardless of lens coating and optical quality as if they were equal, and this is simply not the case amongst different brands and manufactures. No \$50 Binocular purchased at the post office will ever equal a premium grade binocular like Wedgetail for low light detail, even though they have the same exit pupil, which mathematical formulas like Relative brightness and Twilight factor are based on.

Diopter Adjustment:

The diopter adjustment on a binocular allows the viewer to compensate for differences in strength between their left and right eye. Since most people have one eye stronger than the other, this is a feature found on all adjustable focus binoculars.

Wedgetail Raptor Series binoculars contain a locking diopter to protect the setting of the user.

Interpupillary Distance:

The interpupillary distance is the distance between the pupils of the eyes. All binoculars can be opened wider or closed tighter to accommodate the different widths of people's faces

Minimum Focus:

The minimum focus is the minimum distance is the nearest distance at which a binocular will focus on an object. This feature is important for particular applications such as bird watching.

Eye Relief:

Eye relief is the maximum distance your eye can be from the eyepiece and still see the entire field of view. Eye relief is primarily a concern for people who wear eye glasses when

they look through a binocular, as their glasses prevent their eyes from getting too close to the eyepieces.

Waterproofing:

A waterproof binocular is one that is guaranteed to not fog up due to moisture on the inside of the binocular, bearing in mind that any binocular can fog up on the outside lenses. A binocular is made waterproof and fog proof by high quality manufacture and sealing, and is then purged with nitrogen. Other labels such as water-resistant, climate proof and rainproof are not a guarantee to be waterproof.

Wedgetail Raptor Series binoculars are fully waterproof & Nitrogen purged and have the capacity to be immersed in water at 1m depth for 5minutes.

Armouring:

An armoured binocular is a binocular with a housing covered by rubber or other synthetic material. Armouring does not make a binocular waterproof, but it does help protect it from scratches and impact, makes it more comfortable for field use, and also quietens the binocular against potentially noisy impacts while stalking.

Wedgetail Raptor Series binoculars are fully rubber armoured.

Tripod Mounting:

Some Binoculars can be tripod mounted and are listed as "tripod adaptable". This is ideally suited to heavier, higher magnification binoculars of 10x and above, and the threaded socket for the tripod adapter is usually located at the front of the centre hinge and is protected via a rubber cap.

Wedgetail Raptor Series binoculars are tripod mountable and tripod adaptors are sold separately.



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