

Small Binocular Reports The 42mm Roofs
3-4-08
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This is one in a series of “Small Binocular” reports that will detail and summarize all my findings from eight months of tests and measures on over 30 binoculars. Sizes ranged from 8x32, 8x40 and 7x50, up to 10x50s and 12x50s. These are all sizes that could be hand-held and used for either terrestrial use or astronomy. Sprinkled throughout the list of binoculars are several benchmark models that give a good indication what all the others should hope to achieve. Here we have seven roof prism binoculars in 8x42 and 10x42 sizes. Be sure to refer to the other reports, especially the Small Binocular Score, the report showing the summary scores for 16 different measured aspects for all 34 binoculars.

| Binocular Basics | actu | Net | actu | use | range | oz | gm | spec | prism | \$\$\$ |
|--------------------------|-------------|-----------|------------|-----------|--------------|-----------|------------|------------|------------|------------|
| Small Binoculars | Mag | Aper | FOV | ER | IPD | wgt | wft | coat | coat | cost |
| Nikon SE 10x42 | 10.2 | 42 | 6.2 | 17 | 53-74 | 24 | 681 | fmc | fmc | 900 |
| Nikon Monarch 10x42 rp | 10 | 41 | 6.2 | 12 | 55-74 | 22 | 624 | fmc | fmc/p | 299 |
| PentaxDCFHR11 10x42 rp | 10.3 | 40 | 6.0 | 12 | 58-74 | 29 | 823 | fmc | fmc/p | 299 |
| Celestron Regal 10x42 rp | 10.2 | 42 | 6.0 | 13 | 58-74 | 25 | 709 | fmc | fmc/p | 169 |
| Celestron Regal 8x42 rp | 8.1 | 42 | 6.3 | 17 | 58-74 | 25 | 709 | fmc | fmc/p | 169 |
| Bushnell Legend 8x42 rp | 8.2 | 41 | 6.5 | 17 | 58-74 | 25 | 709 | fmc | fmc/p | 249 |
| Garrett DCF 8x42 Apo rp | 8 | 41 | 6.7 | 19 | 57-71 | 23 | 653 | fmc | fmc/p | 200 |
| Oberwerk 8x42 rp | 8.3 | 34 | 5.8 | 14 | 58-73 | 24 | 681 | fmc | | 129 |
| Fujinon BFL 8x42 | 8.0 | 40 | 6.5 | 11 | 57-73 | 24 | 681 | fmc | fmc | 189 |

Values are measured actual magnification x effective aperture, True field of view, usable eye relief, interpupillary range, weight, lens coat/prism coat and retail purchase price. The Nikon SE 10x42 and the Fujinon BFL 8x42 are included as benchmarks.



Left to right: Garrett, Bushnell, Celestron Regal, Regal, Nikon, Pentax, Oberwerk

More Basics

Most of these weigh 24-25oz. (680-710g.). The Nikon is the lightest at 22oz. (620g.), then the Garrett at 23oz. (650g.). The Pentax is the heaviest at 29oz. (820g.)

I like the Regal LX eyelens cover. I don't like the objective push-in caps. The Nikon, Pentax, Oberwerk and Busnell all have captive objective caps, something I think should be expected in a binocular designed typical for terrestrial use. The Pentax eye lens cover is so loose, it falls off.

The Regal binocular bracket hole cover cap is easy to get off (more than I can say for some of the other roofs), and there is plenty of room to fit a narrow profile L bracket between the barrels of the Regal (also more than I can say for some of the other roofs). Keep in mind, you don't get a lot of room for an L bracket between the barrels of a roof prism binocular. At my IPD of 62mm, there's only 14mm between the barrels for an L bracket in the Regal. All the others have less room. The bracket that came with my Oberwerk Ultra 15x70 is only 10mm wide and works perfectly. No other standard L bracket I own would work. None of these can be used on the Far Sight Binocular Mounting bracket. I do have a velcro strap style adapter from Eagle Optics that works well with all of them. However, I must say, difficulty mounting small roof prism binoculars should not be considered a problem. Very few people will be mounting these.

The Regal has a push/pull eyeguard with one positive click midway. It did not move from the midway or full out click positions. The eyeguard on the Nikon Monarch is twist out and can be set to any number of positions with no movement at all and is much smoother than the Regal. The Pentax and Garrett both twist and lock only when full out. The GO slips at any intermediate position. The Oberwerk eyeguard twists, is smooth with no detentes and stays put. The Bushnell twists to three positive detente settings. The Nikon Monarch, the Oberwerk and the Busnell Legend offer the most positive positioning and adjustment for the user.

The Regal is waterproof/fogproof, O-ring sealed and nitrogen purged. But, if I'm not mistaken, so are the Pentax HR II, the Nikon Monarch, the Bushnell Legend and the Garrett Apo. The Oberwerk is listed as waterproof, but unlike all these others which have internal focusing the Oberwerk has an eyepiece bridge and external focusing.

The Garrett has the least pincushion. All the rest appear to have about equal pincushion, none of them severe. Keep in mind pincushion has absolutely no affect on astronomical observing. However, it does have considerable affect for terrestrial users, and most of these could be considered good cross-over binoculars. A small amount of pincushion is desirable as it helps eliminate the rolling ball effect for terrestrial use. So there will be some meaningful criteria that affect one group of users and not the other.

Eye Relief – Diopter - IPD

The eye relief on all of these is specified as between 16-22mm. Only the Bushnell (17mm) and the Garrett (19mm), have usable eye relief that comes close to the specified values. The

Pentax is specified at 22mm, it actually has only usable eyerelief of 12mm. The Garrett eye lenses, when the eyecups are turned fully down, are only 2mm below the eyecup, insufficient distance to prevent contact with eye glasses, requiring that the eyecup be twisted out somewhat so my eyeglasses don't hit the binocular eye lens. However, the eyecup just won't stay put at any intermediate positions. To keep it from moving during use, it must be either all the way in or all the way out. So, while the Garrett roof has the most eye relief, and the most usable eyerelief with the cups down, it is the least accommodating to the eyeglasses wearer.

| Eye Relief | spec | dist | rcss | usable | usable |
|--------------------------|-----------|-----------|----------|-----------|----------|
| Small Binoculars | ER | exit | lens | ER | w/cup |
| Nikon SE 10x42 | 17 | 20 | 3 | 17 | 7 |
| Nikon Monarch 10x42 rp | 16 | 17 | 5 | 12 | 3 |
| PentaxDCFHR II 10x42 rp | 22 | 17 | 5 | 12 | 4 |
| Celestron Regal 10x42 rp | 16 | 17 | 4 | 13 | 6 |
| Celestron Regal 8x42 rp | 20 | 21 | 4 | 17 | 7 |
| Bushnell Legend 8x42 rp | 18 | 21 | 4 | 17 | 9 |
| Garrett DCF 8x42 Apo rp | 20 | 21 | 2 | 19 | 9 |
| Oberwerk 8x42 rp | 20 | 19 | 5 | 14 | 6 |
| Fujinon BFL 8x42 | 15 | 17 | 6 | 11 | 5 |

With the curvature of my eyeglass lenses, at least 3mm depth is needed below the eyeguard to keep eyeglass lenses from hitting and scratching the binocular eye lens, or just as bad, scratching my eyeglass lenses. It would cost me more to replace my eyeglass lenses than it would to replace these binoculars. The Celestron Regal LX has 4mm depth. The Pentax HR II, the Nikon Monarch and the Oberwerk all have 5mm clearance when the eyecup is down. The Bushnell Legend has 4mm. All of these others have the rubber eyeguard raised just enough above the metal eyepiece edge rim to prevent the metal from touching my eyeglasses.

Some of these binoculars have a right diopter ring that seems designed to prevent it from accidentally being moved. They are narrow, low profile, under the right eyecup, difficult to grip, and so tight that it's difficult to turn them while looking through the binocular. The Nikon Monarch and the Pentax were the most difficult (or best if you feel these are advantages. I didn't think so). The Bushnell right diopter ring is prominently raised and is the easiest to use overall. The Celestron Regal is unique in that the right eyecup is push/pull for eye relief and is twist for diopter. The first 8xRegal I received broke within 2 days. The 10xRegal diopter is very smooth, the 8xRegal is very coarse and stiff.

Most of these are very similar in IPD range, from 58-74mm. The Nikon Monarch will accommodate the greatest range, from 55-74 and the Garrett from 57-71. While 58 is close enough for most people, many children and some adults will need that 57mm or 55mm setting to see with both eyes.

Close Focus

Most of these have 6-7ft. close focus. The Garrett can focus to 5ft., the Pentax to 12ft. and the Oberwerk to only 19ft. With slight variation +/-, they all have only about 70% of the field of

view overlapped in binocular vision at 7ft. However, when focused at 20ft., they all have approx. 90% of the field overlapped for binocular vision.

What you really get with these binoculars when it comes to close focus (assuming at 10ft) is a "binocular vision" field of view about 10 inches wide. Both the Bushnell Legend (6.5° fov) and the 10xRegal (6.0°fov) show nearly identical results. At a distance of 10 feet they can see 31-32cm with only 25 cm of that field overlapped, so for binocular vision they see 10 inches out of just over 12 inches. In these same binoculars, when viewing at 100 feet (30m) the barrel overlap is off by less than 5% of the fov and you get a 10 foot wide view with binocular vision while only 6-8 inches is not overlapped.

Internal Focus

Most all of these roofs are internal focus. In most of them I can observe the internal sliding mechanism sleeve in front of the prism. If a binocular is internal focus, and therefore, the eyepieces do not move, then an internal lens is moving to achieve focus and therefore focal length and resultant light cone gets modified slightly so the focal point will hit the unmoving eyepiece to change from close focus to infinity. That probably means all these roofs are changing magnification as you move towards closer focus. I did a quick check of the 8xRegal at a focus distance of about 10ft and found magnification close to 8.5x. I also checked the 10xRegal and found magnification was 10.5x or slightly greater. That's a 4-5% increase in magnification for both of those. The Pentax shows about 10.8x at close focus, again about a 5% increase. The Bushnell shows about 8.6x, an increase of 5%.

Slow or Fast Focus

As I've done with all the binoculars in the Small Binocular studies, I've attempted to class them as slow or fast focus. So, I measured the dial degrees turn needed to go from 3 meters to 30 meters (10feet to 100feet) and then measured the degrees turn to go from 30m to 100m (100ft to 300ft). Both Regals take only 30° of focus dial turn to focus from 30M to 100M. Typical fast focus binoculars have a total dial turn 20° to 60° for the 30M-100M range. Half of all the binoculars measured fall into this fast focus range, although none are 10x50s or larger except for the Nikon AE12x50. So for 30m-100m, the Regal could be considered fast focus.

| Close Focus | **** | close | dial | dial |
|--------------------------|-----------|-----------|------------|-----------|
| Small Binoculars | focus | focus | 3-30 | 30-100 |
| Nikon SE 10x42 | CF | 13 | 300 | 60 |
| Nikon Monarch 10x42 rp | CF in | 7 | 180 | 30 |
| PentaxDCFHR11 10x42 rp | CF in | 12 | 300 | 60 |
| Celestron Regal 10x42 rp | CF in | 7 | 300 | 20 |
| Celestron Regal 8x42 rp | CF in | 6 | 300 | 30 |
| Bushnell Legend 8x42 rp | CF in | 7 | 180 | 30 |
| Garrett DCF 8x42 Apo rp | CF in | 5 | 270 | 60 |
| Oberwerk 8x42 rp | CF | 19 | 180 | 25 |
| Fujinon BFL 8x42 | CF | 14 | 145 | 45 |

BUT, and here's the catch, in the close range from 30m to 3m (100ft to 10ft), the Regals takes 300° of dial turn to focus. Based on the 34 binoculars in my test group, this is very SLOW

focus for this close 3m-30m range. The fast focus binoculars in my test group cover this same distance range with anywhere from 100° to 180° of dial turn. Only ONE binocular I've measured was slower focus than 300° in this range. In the 3m to 30m range, the Regals are among the slowest focusing binoculars available, potentially not conducive to near birding in that close 3m-30m range.

All of these binoculars are fast focus in the range from 30m to 100m (100ft to 300ft). Only the Nikon Monarch, the Bushnell Legend and the Oberwerk are fast focus in the range from 3m to 30m (10ft to 100ft).

FOV and Field Sharpness

Of the three 10x42 roofs, the Nikon Monarch is widest at 6.2°, the Pentax HR II and the Celestron Regal LX are both 6.0°. Of the 8x42 roofs, the Celestron Regal is 6.3°, the Bushnell Legend is 6.5° and the Garrett Apo is 6.7°. The Oberwerk 8x42 is 5.8°.

The 8xRegal has by far the best sharp fov, what could be considered sharp to the edge fov, with only 1 arcmin total distortion all the way out at 95% of the field. There are only four other binoculars in these tests that could equal or exceed that mark. All four are benchmark binoculars, two Fujinons and two Nikon SEs. All of these roofs held on to a maximum of no more than 1 arcminute distortion all the way out to 70% of the field, the 10xRegal out to 80%.

After that the Garrett was the quickest to break down and in fact before 75% had 2 arcmin distortion. Two arcminutes of total distortion in your image provides no more useful information. Stars are either distorted blobs or long streaks. The image has lost perhaps two full magnitudes of faint stars. Both the Bushnell and the Oberwerk quickly fell off by 75% out. The Nikon Monarch and the 10xRegal did not hit 2 arcmin of total distortion until 90% out.

| Field of View degrees | spec | actu | calc | sharp% | sharp% | sharp | limit |
|--------------------------|------------|------------|-----------|-----------|------------|------------|------------|
| Small Binoculars | FOV | FOV | Afov | 600arc" | 1200arc" | fov | fov |
| Nikon SE 10x42 | 6.0 | 6.2 | 63 | 85 | 100 | 5.3 | 6.2 |
| Nikon Monarch 10x42 rp | 6.0 | 6.2 | 62 | 75 | 90 | 4.7 | 5.6 |
| PentaxDCFHR II 10x42 rp | 6.0 | 6.0 | 62 | 70 | 80 | 4.2 | 4.8 |
| Celestron Regal 10x42 rp | 6.0 | 6.0 | 61 | 80 | 90 | 4.8 | 5.4 |
| Celestron Regal 8x42 rp | 6.5 | 6.3 | 51 | 95 | 95 | 6.0 | 6.0 |
| Bushnell Legend 8x42 rp | 6.3 | 6.5 | 54 | 75 | 75 | 4.9 | 4.9 |
| Garrett DCF 8x42 Apo rp | 7.0 | 6.7 | 54 | 70 | 70 | 4.7 | 4.7 |
| Oberwerk 8x42 rp | 6.0 | 5.8 | 48 | 75 | 75 | 4.4 | 4.4 |
| Fujinon BFL 8x42 | 6.5 | 6.5 | 52 | 85 | 90 | 5.5 | 5.9 |

It would seem that one reason for that high level of outer field sharpness in the 8x42 is the fact that the 8x42 Regal has very narrow Afov eyepieces, low for any 8x binocular I've used. All these 10x roofs have eye pieces with 62-64° Afov. Of the four 8x roofs, none have eyepieces with greater than 54° Afov. The 8x42 Regal has a 51° Afov eyepiece, similar to most Pentax porro binoculars.

The 8xRegal, following on its excellent sharp field performance also has the widest usable fov, a full 6.0° of good fov. The next best, the Bushnell has less than 5° of fov that can match the sharpness of the Regal. The Pentax has just more than 4° fov usable.

Curvature and Depth of Field

The Bushnell Legend and the Pentax have by far the most field curvature. The Bushnell has 1 arcmin of curvature at 60% out in the field, and 90 arcsec at 90% out. The Pentax has 40 arcsec at 60% out, but more than 2 arcmin at 90% out. The Nikon and 10xRegal have very little curvature, the 8xRegal has almost none.

It seems that binoculars with more field curvature may have greater depth of field in front of the focus point. It would seem therefore that a field flattener lens, which would be desirable for an astro viewer to get as flat a field as possible, might work against a terrestrial viewer looking for the greatest depth of field.

An astronomer would prefer all binoculars to have as little field curvature as possible so the entire plane of the fov has as little distortion as possible. It is not unusual to find that a binocular with much less sharpness out at 60% or 70% in the fov has a much greater amount of field curvature than a binocular which appears sharp out to 80-90% of the fov. A terrestrial viewer might want to consider how field curvature affects the view, and may in fact find field curvature to be a useful aberration. While it does nothing to add to depth of field further distant than the plane of focus, field curvature provides for closer objects to appear in focus as they range out across the fov.

Depth of Field example:

The Fujinon BFL 8x42 has low field curvature (approx 15 arcsec curvature at 60% out, 25 arcsec at 70% out and still only 60 arcsec of curvature at 90% out). Basically, that's pretty close to a flat field. When focused at 50m, objects at 40m appear sharper at 30% out in the field and objects at 30m appear sharper at 50% out, but objects at 25m are not in focus and cannot be seen better anywhere in the field. I would say the BFL has a narrow depth of field.

The Celestron Regal 10x42 has more field curvature than the Fujinon BFL (only 5 arcsec at 60% out, and only 20 arcsec at 70% out, but 100 arcsec at 90% out). When focused at 50m, objects at 40m appear sharper at 50-60% out in the field and objects at 30m appear sharper at 80% out. Objects at 25m can be seen at 80% out in the field. I would say the 10xRegal has more depth of field than the Fujinon BFL, but still somewhat narrow.

The Bushnell Legend 8x42 has the most field curvature of these three (45 arcsec at 60% out, 75 arcsec at 70% out, 100 arcsec at 90% out). When focused at 50m, objects at 40m appear sharper at 30% out in the field and objects at 30m appear sharper at 40% out. Objects at 25m are seen clearly at 70% out in the field and objects even slightly closer are seen clearly further out in the field. The Bushnell has the most field curvature and has the widest depth of field range.

The Nikon Monarch has little curvature and the Celestron Regal 8x42 has almost no curvature, Both have less depth of field than my best example the Nikon AE 8x40.

Aperture

With small exception most of these either equal the specified aperture or lose only 1mm to internal baffles. The Pentax is effectively only 40mm. The Oberwerk roof is poorly designed with an internal baffle near the prism that stops the aperture down to 35-36mm. Then in addition to that the prisms are too small to span completely across the prism aperture, so it loses another 4%. The effective aperture of the Oberwerk is only 34mm.

Baffling

In the Regal, interior baffles and blackening are pretty good. There are two metal baffle rings and the inside wall is cut with ridges and blackened. There is some grey metal near the prism housing, but it is pretty dull grey. The Pentax has the finest, darkest, duldest black/grey interior baffles. The Nikon Monarch is similar to the Regal. The Garret and the Bushnell Legend have the most bright grey metal in near the prisms. None of the above are really poor in this respect. The Oberwerk baffle appears to be molded plastic. It interferes with the light beam before entering the prism and can be seen to drastically reduce the aperture.

Coatings

All these binoculars appear to have multi-coated objectives and eye lenses. The Celestron Regal by far appears to have coatings that reflect the least amount of light. Coatings should not reflect light. The Oberwerk objective coatings are similar to the Nikon and Bushnell, but it appears the Oberwerk prisms are uncoated. The Pentax HR II coatings reflect more light than all of those four. The Garrett Apo reflects the most light off the objective lens. The difference here from best to worst is that it was very difficult for me to see my reflection in the Regal or the Monarch and no detail at all could be seen, but in the Pentax it was easy to see detail in my reflection. In the Garrett, I could easily see facial features in detail and could see the color of my shirt. In tests, the Garrett records the lowest LM, seemingly in agreement with the highest reflectivity in the coatings. All of them are listed as FMC and phase coated. I doubt the Oberwerk is FMC. Also, it appears from testing that the Oberwerk is not phase coated. The Bushnell has "rainguard" coatings. If you've ever used rainguard applied to your windshield, you know it virtually eliminates the need to use wipers in the rain. This coating is intended to do the same on the Bushnell.



Top to bottom: Pentax HR II, Celestron Regal, Nikon Monarch

Limiting Magnitude

I never had these all out under the same skies, but I have a variety of mix and match observations. The three best out of this group are the 10xRegal the 8xRegal and the Bushnell. The Bushnell would always just neck out a better reading than either the Nikon or the Pentax by 1/10th magnitude. Any of those three consistently did better than the Garrett by 3/10th to 1/2 a magnitude. The Oberwerk was by far the poorest of the lot, in fact always beaten out by every other binocular in this entire list. I never saw a star deeper than mag 9.1 with the Oberwerk. The Bushnell saw stars as deep as 9.6. The Regals saw deeper than any others. In conditions when the Bushnell saw mag 9.4, the 8xRegal could see 9.6. When the Bushnell saw 9.6, the 10xRegal saw 9.8.

Prism Vignette and Illumination

The Garrett, both Regals and the Bushnell all gave very good readings for control of internal vignette and lack of tilt in the light path. None of the above had any significant tilt and all showed very good transfer of the test beam into the exit pupil. The Oberwerk and the Pentax were by far the worst, both showing dramatic tilt in the light path and considerable vignette of the beam before it reached the exit pupil. In both instances, even with the test beam in the very center of the objective lens, large portions of a 5° beam were cut off and never reached the exit pupil. No position could be found on the objective lens where the entire beam would pass to the exit pupil.

Normal function shows the entire 5° wide circle and crosshairs laser target pattern will pass thru when the test beam is placed perpendicular to the optical axis and anywhere within the central 20-30% of the objective lens. The Fujinon BFL 8x42 set the highest standard for superior function by transmitting the entire beam pattern from every point in the central 50% diameter of the objective lens. The Pentax roof and the Oberwerk roof had the lowest scores for internal prism vignette of all binoculars tested in this study.

| Light Transfer | tilt | tilt | 100% | 75% | Exit | MAX |
|--------------------------|----------|----------|-----------|-----------|------------|------------|
| Small Binoculars | left | right | beam | beam | Pupil | Lux |
| Nikon SE 10x42 | 0 | 0 | 20 | 50 | 4.2 | 618 |
| Nikon Monarch 10x42 rp | 8 | 15 | 0 | 40 | 4.1 | 574 |
| PentaxDCFHR II 10x42 rp | 20 | 20 | 0 | 45 | 4.0 | 491 |
| Celestron Regal 10x42 rp | 10 | 2 | 10 | 50 | 4.1 | 538 |
| Celestron Regal 8x42 rp | 10 | 2 | 10 | 50 | 5.1 | 579 |
| Bushnell Legend 8x42 rp | 4 | 3 | 15 | 55 | 5.1 | 560 |
| Garrett DCF 8x42 Apo rp | 10 | 2 | 35 | 55 | 5.2 | 660 |
| Oberwerk 8x42 rp | 10 | 15 | 0 | 35 | 4.4 | 373 |
| Fujinon BFL 8x42 | 7 | 3 | 50 | 70 | 5.0 | 751 |

The Garrett, the Nikon and the 10xRegal do very well with illumination of the exit pupil. Reflecting the severe vignette recorded above, the Oberwerk had the worst reading for illumination recorded in this entire study.

While the Garrett transferred the light beam very thoroughly and evenly, it was never able to see fainter stars than most all of these others. Perhaps that was due to the fact the Garrett has more reflective coatings and just didn't let as much light thru. Total transmission is the result of not just how well the beam is transmitted, but how much light is in the beam, and neither of those can simple be determined from the total aperture or the quality of the coatings.

Resolution

The 10xCelestron Regal, the 8xRegal and the Bushnell all have very good normal resolution, three of the top 10 measured resolution values in all 34 binoculars tested. The 8xRegal and the Bushnell could both see to 10.3 arcseconds, the 10xRegal, the best, down to 8.1 arcseconds.

The Nikon Monarch and the Pentax have the lowest scores for resolution, two of the worst values recorded for normal resolution.

| Resolution USAF chart | actu | USAF | apprnt | boost | USAF | apprnt | USAF | |
|------------------------------|-------------|-------------|-----------|-----------|------------|------------|-------------|------------|
| Small Binoculars | Mag | res | res | Mag | x6.15 | res | res | hheld |
| Nikon SE 10x42 | 10.2 | 8.1 | 83 | 63 | 3.6 | 227 | 11.5 | 117 |
| Nikon Monarch 10x42 rp | 10 | 9.7 | 97 | 62 | 5.7 | 353 | 12.9 | 129 |
| PentaxDCFHR11 10x42 rp | 10.3 | 9.1 | 94 | 63 | 6.1 | 385 | 14.5 | 149 |
| Celestron Regal 10x42 rp | 10.2 | 8.1 | 83 | 63 | 3.6 | 227 | 14.5 | 147 |
| Celestron Regal 8x42 rp | 8.1 | 10.3 | 83 | 50 | 4.1 | 204 | 16.0 | 130 |
| Bushnell Legend 8x42 rp | 8.2 | 10.3 | 84 | 51 | 5.4 | 274 | 14.5 | 119 |
| Garrett DCF 8x42 Apo rp | 8 | 10.8 | 87 | 49 | 5.4 | 266 | 15.3 | 122 |
| Oberwerk 8x42 rp | 8.3 | 10.8 | 90 | 51 | 6.5 | 331 | 17.2 | 143 |
| Fujinon BFL 8x42 | 8.0 | 10.3 | 81 | 49 | 4.6 | 223 | 14.5 | 115 |

Boosting the resolution test power by 6x normal, once again the Nikon Monarch and the Pentax have the worst readings for boosted resolution, again both among the worst in this study. The Garrett and the Bushnell did very well, both able to see 5.4 arcseconds. The Celestron Regals stood above all others with some of the best boosted resolution in the entire study. The 10xRegal could see 3.6 arcseconds and the 8xRegal could see 4.1 arcseconds for an apparent resolution of 204 arcseconds, one of the finest resolution values recorded among all 34 binoculars.

An interesting difference was when I attempted handheld resolution. I could not hold the Regals steady enough to get a better reading than the 10x42SE. The Regals ended up in the middle of the pack for handheld resolution, but the Nikon 10x42 SE was able to see approx 20% finer resolution than either Regal. The Nikon SE came out very near the top rank. In fact, the Bushnell Legend is the only roof among the top group for handheld resolution, all the rest are small porros.

Observing

M1 M78 observations

Viewing M1 under mag 5.2 skies,

M1 - this one was tough. It was not seen at first. But after locating it in the 15x70, it was a bit easier to detect in the 10x50s. It was barely detected with great difficulty in the BFL 8x42.

M78 - this seemed more difficult than M1. I had a hard time finding it and needed to get a chart for exact location. Once I pinpointed its location, I could just barely detect it in 10x50s. I did not see it at all in the 8x42BFL.

M78 under mag 5.0-5.2 skies

In a Nikon SE 10x42, M78 was easy.

Celestron Regal Roof 10x42 it was not easy but was seen OK.

Bushnell Legend 8x42 Roof, just barely seen

M78 seen in all, but with difficult in 7x and 8x.

Saw M78 in Bushnell handheld braced.

M78 under mag 5.2-5.4 skies

Nikon Monarch ATB 10x42 Roof, seen good.

Bushnell Legend 8x42 Roof, seen averted

M78 under mag 4.9-5.0 skies

Fujinon 10x50, M78 was immediately visible. Central stars are not seen.

Nikon Action 10x50, not easy but was seen OK.

Celestron Regal 8x42 roof, it was just barely seen

Could not find it in any binocular handheld.

M1 under mag 4.9-5.0 skies

Fujinon 10x50, M1 was seen only after concerted effort and chart reference.

Nikon Action 10x50, took repeated tries to find it, even averted.

Celestron Regal 8x42 roof, took even more time and when I did suspect seeing it with averted vision, it was questionable.

Not seen in any handheld or braced.



Front row: Celestron Regal 10x42, Celestron Regal 8x42, Garrett Apo 8x42

Middle: Bushnell Legend 8x42, Nikon Monarch 10x42

Back row: Pentax DCF HR II 10x42, Oberwerk 8x42

Summary

Nikon Monarch ATB10x42 Roof –10x41, 6.2°, er=12mm, IPD=55-74, cf 7ft, fmc/fmc-p, The Monarch is fast focus and weighs only 22oz. It has quite short eye relief due to the deeply recessed eye lens, only 12mm usable maximum. The eye guard twists out and has only one click position at all the way out. However, the eye guard is quite stable at any position and does not move under pressure. The Nikon has a generous field of view for a 10x binocular and most of it is sharp and usable. However it has poor resolution. The Nikon Monarch has little curvature. Internal prism vignette is tilted and measures poorly, however illumination is good. Coatings are good, and LM is fairly high, but contrast is a step down from the best here. A good binocular, but not my favorite choice.

Pentax DCFHR II 10x42 Roof -10.3x40, 6.0°, er=12mm, IPD=58-74, cf 12ft, fmc/fmc-p FOV od 6.0° is ample for a 10x binocular, with 70-80% usable. Overall rank is close to the bottom of the list for resolution normal, resolution boosted 6x and resolution handheld. It rated in the lowest group for distribution and balance of light within the exit pupil. Could be considered slow focus, not really a desirable trait if you are a birder. Almost an 11x40 at closest focus. Has the most pincushion of all the roofs. Eye relief tight, but just barely sufficient. The Pentax is the heaviest of the roofs at 29oz. (820g.). Scores low due to difficult diopter, very poor resolution and internal vignette. Others do better.

Celestron Regal 10x42 Roof- 10.2x42, 6.0°, er=13mm, IPD=58-74, cf 7ft, fmc/fmc-p Coatings are among the best. Eye relief is just sufficient for eye glasses. The Celestron Regal has a lifetime no-fault warranty. If it breaks or becomes unusable, no matter whose fault, Celestron will repair or replace the binocular for just a \$25 shipping and handling charge. The internal vignette test shows a perfectly balanced image with little to no vignette. Illumination is very good. Resolution is excellent. LM is the highest of the roofs. Good balance between flat field and field curvature for depth of field. The 10x42 Regal is an excellent crossover binocular. Easy to recommend this one.

Celestron Regal 8x42 Roof - 8.1x42, 6.3°, er=17mm, IPD=58-74, cf=6ft, fmc/fmc-p The 8x42 has ample eye relief and coatings are among the best. The Regal 8x42 has almost no field curvature and has one of the widest usable field of view of any binocular in this entire study. It is slow focus at close range, but fast focus otherwise. The internal vignette test shows a perfectly balanced image with little to no vignette. Illumination is good. LM shows near equal to some of the best 10x50s. Resolution is excellent. The 8x42 Regal is an outstanding astronomy binocular for its ease of use at the eye, excellent contrast, deep limit and low aberration wide field. I suppose these are all attributes that would make it a good terrestrial binocular also.

Bushnell Legend 8x42 Roof – 8.2x41, 6.5°, er=17mm, IPD=58-74, cf=7ft, fmc/fmc-p The Bushnell is fast focus and weighs 25oz. I especially like the contoured shape of this binocular and found it to be one of the most comfortable handheld. Everything works easily and does what it is supposed to do, providing a wide range of adjustability for different users, although IPD could be tight for children. It has moderate marks for field sharpness, but it has the widest usable fov next to the 8xRegal. Contrast was not quite as good as the Regal. It

shows very good resolution and gave one of the highest marks for handheld resolution. The Bushnell may not be the best in any category, but it does a lot of things very well and doesn't do anything really poorly. Highly recommended for both terrestrial or astronomy.

Garrett DCF 8x42 ApoRoof - 8x41, 6.7°, er=19mm, IPD=57-71, cf=5ft, fmc/fmc-p
Widest fov of all the roofs. no false color at all, bright image, one eyecup constantly changed position needed to reset it every time I used it. No pincushion at all, may reduce desirability for terrestrial use. Very compact, very comfortable to carry around. Has nice image and ample eye relief. All resolution values are good and shows little axial tilt and transmits internal beam well, indicating little internal prism vignette. Looses points for lack of wide sharp fov, low LM, loose eyecup and difficult diopter. Still a good performer. Except for the finicky eyecup, I enjoyed this one for terrestrial use. If I wanted to see the faintest stars, I'd pick another.

Oberwerk 8x42 Roof - 8.3x34, 5.8°, er=14mm, IPD=58-73, cf=19ft, fmc/fmc
Considerably darker view than most of the other 8x42s. Of course the discovery that the effective aperture measures only 34mm explains a lot of that. However, the field stop is not visible, so the field edge appears grayed. The prisms appear to be uncoated. Both internal prism vignette and illumination are very poor. Resolution ranks among the worst binoculars in this entire study. Limiting magnitude recorded is below most others of this size, no better than two 8x32 porros. This was the lowest scoring binocular in this entire study. Not recommended.

A few words about the benchmarks:

Nikon SE 10x42 - 10.2x42, 6.2°, er=17mm, IPD=53-74, cf=13ft, fmc/fmc,
Very light at 24oz. (680g). No false color noticed. Very little field aberration, but mild curvature. Quite comfortable handheld, ample eye relief, not as much blackout issues as the 12x50SE. Relatively fast focus 30m-100m, but slow focus 30m-3m. Interior baffles and blackening is excellent, no internal reflections. Reaches the same LM as the 10x42Regal, the deepest of the roofs and better than many 10x50s. Extended object contrast is superior, better than the 10xRegal. Measures near best in normal power on-axis resolution, 6x boosted resolution and handheld resolution. Nearly sharp to the edge, usable field of view about 90% fov. Not waterproof. Aperture is true 10x42 and system shows very good transfer of light beam. Coatings are among the best made.

Fujinon BFL 8x42 - 8x40, 6.5°, er=11mm, IPD=57-73, cf=14ft, fmc/fmc
Very light at 24oz. (680g). No false color at all, no field curvature at all, very light and comfortable, although it would be nice if eye relief were about 2-3mm longer. In the short range, they are faster focus than any of the roofs. Just barely enough eye relief for me to use with my eyeglasses. Very well baffled interior of objective tubes, no internal reflections. Has one of the best on-axis resolution marks but also they hold up to show some of the best 6x boosted resolution AND they exhibit some of the best outer field sharpness. Focuses stars to very fine pinpoint. These are waterproof, nitrogen purged, aluminum alloy construction. They have a lifetime warranty. Right eyepiece has a clickstop diopter adjustment, very positive.

The 8x42BFL are very comfortable in the hand, and at the eye. Right up to the eye, quick to grab the view, easy and quick to focus.

Some of these roofs make excellent astronomy binoculars. The Celestron Regals, especially the 8xRegal, the Nikon Monarch 10x42 and the Bushnell Legend 8x42, are all good choices. As a bonus, these choices equip the user with a nice lightweight piece that can be used for terrestrial use.

Clear skies, and if not, Cloudy Nights
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