

## **Bioptic Telescope Spectacles for Driving by the Visually Impaired An Introduction for DMV Boards and Driver Examiners**

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### ***Introduction***

Bioptic telescopes are eyeglasses that contain miniature telescopes mounted toward the top of the eyeglass lens(es). They function in the same way as binoculars by enlarging images at a distance. While binoculars might be used continuously, drivers using bioptics look through their regular eyeglass lenses almost all of the time, and only sight through the telescope episodically and for brief periods of time.

Bioptic telescopes may help an otherwise competent visually impaired driver to be a safer driver by helping them to see further ahead to maintain lane position, see signs, signals, obstacles, traffic, pedestrians, etc. sooner and hence provide them more time to take appropriate driving actions. This benefit is expected to allow the driver to be safer on the road. Since the driver will use their regular vision (through conventional eyeglasses if required) more than 90% of the time, if they are not a competent driver without the bioptic, the telescopic device will not improve their ability to drive safely. In addition, not all competent drivers will be able to learn to use a bioptic effectively for driving for reasons including difficulty tracking and image stabilization of the magnified image, as well as other reasons.

### ***State DMV vision and bioptic regulations***

Regulations regarding whether an individual with a visual impairment can use a bioptic telescope to be eligible for a driver's license varies between states—and in a handful of states it is not allowed.

- The variables that may be considered by the individual states include:
- Minimum visual acuity (worst vision) through the conventional eyeglass lenses (carrier lenses) if used
- What the field of view of the individual is through the carrier lenses
- The visual acuity through the bioptic
- Field of view of the telescope
- Whether the bioptic can be prescribed to only one eye or both eyes
- Whether there is a maximum telescope power acceptable
- Whether the bioptic can be focusable or not
- Amount of training required for novice and previous drivers
- What restrictions might be applied to the license, such as:
  - Speed limit
  - Time of day (no night driving)
  - Distance from home
  - No interstate
  - Frequency of review

### ***The benefit of bioptic telescopes for the visually impaired driver***

The challenge that the visually impaired encounter while driving is that they must get so close to a sign, signal, obstacle, or traffic that there may be insufficient time for them to make appropriate driving adjustments. The bioptic telescope allows them to see the target sooner, giving the driver more time to respond. In practice, the telescope increases the individual's ability to see further ahead by a factor of the power of the device. For example, a 4x telescope will allow the user to see a sign at 80 feet through their bioptic, while they would only be able to see it at 20 feet with their normal vision- a 4 times distance gain.

Recently and with the advent of GPS, the traditional purpose of prescribing bioptic telescopes for reading signs (way-finding) has been called into question. If the intention of a bioptic is to make the driver safer on the road, it is not obvious that higher magnification telescopes, with their inherent narrower fields of view, intended for sign reading, will be of as much value as lower power, wider field devices that will allow the driver to see a full lane on the road to be more aware of lane position, obstacles on the road and traffic and pedestrian patterns. In addition, higher power telescopes magnify image movement and even slight head and car movements can move the image enough to potentially undermine the benefit of the higher power telescope.

### ***Types of Bioptic Telescopes and Fields of View***

Bioptic telescopes are available as either small, Galilean optical designs which provide ample fields of view in lower powers (up to about 2.2x), and larger, heavier Keplerian design telescopes, which offer significantly wider fields of view- usually about 12 degrees and are available in powers from 3x to 6x.

### ***User issues regarding bioptic telescopes***

When individuals first look through a bioptic telescope they will notice that everything looks much closer (which is true) but the benefit to the individual is that it will allow them to see that much further away (by a factor of the power of the telescope).

Their other observation is that the field of view is narrower (just as it would be while looking through a binocular). Clinical experience shows that when fields of view are narrower than 10 degrees (about the width of one's upraised hand held at arm's length) it is difficult for the user to find what they are looking for. As a result, Galilean telescopes are usually prescribed when lower powers are required to achieve the desired acuity (preferably 20/40, but at least 20/70). When higher powers are required (usually above 3x) Keplerian telescopes are preferred as they provide markedly wider fields of view as compared to higher power Galilean designs.

### ***Learning to use bioptics for driving***

While driving, bioptics are used for brief spotting purposes -- in much the same way that we use side and rear view mirrors. Automobile mirrors are quite small, and in fact provide narrow fields of view themselves, quite comparable, in fact, to the field of view through a bioptic telescope. When we first learned to drive, most of us found mirrors difficult to use and we often preferred to turn our heads to make certain that the way was clear. Over time, using mirrors became easy and natural, and ultimately indispensable. The "learning curve" involved in using bioptic telescopes is much the same as that experienced when using mirrors.

Certified driving instructors and occupational therapists may have training and experience to help visually impaired individuals to learn to use their bioptic telescope for driving. It is often advisable, and required by the NC Bioptic Driving Legislation, that new bioptic drivers receive training in using their bioptic telescope for driving. Bioptic drivers who move to North Carolina from other states and already have a bioptic driver's license are not required to take bioptic driver training. One must appreciate the difference between a clinical driver assessment (provided in an office) and a behind-the-wheel driver assessment where an extended on-road assessment of driving fitness is provided. While a clinical evaluation may identify those who ought not drive, it cannot insure that the individual will pass an on-road test.

### ***Understanding the visually impaired driver***

Individuals born with visual impairments from disorders including albinism, nystagmus, photoreceptor dystrophies, optic nerve hypoplasia, coloboma, and those who develop vision loss at younger ages such as Stargardt's Disease usually develop a more robust and stable visual function than individuals who have experienced vision loss in their adult years (from AMD, diabetes or glaucoma, for example). Individuals who have reduced central vision usually develop an eccentric-viewing position (Preferred Retinal Locus or PRL). A well-established eccentric viewing position will support more stable visual functioning--important in extended visual activities such as driving. Individuals who have more recent vision loss, or more extensive disease, or are older, may not demonstrate consistent eccentric viewing, which may undermine their ability to drive safely (with or without the use of a bioptic).

As mentioned previously, individuals with BCVA between 20/100 and 20/200 were not eligible for a driver's license. With the bioptic driver legislation, they may, with the use of a bioptic, now be eligible for a restricted license.

However, these individuals must be a competent driver without the use of a bioptic. Care must be taken to insure that such an individual will not purchase a bioptic solely with the expectation that it will allow licensure, when they would not be eligible to drive due to other reasons.

### ***The Ring Scotoma***

When looking through a bioptic telescope the enlarged image obscures some of the normal field of view. This area of lost vision is called the "Ring Scotoma." Because some visual information is missing while sighting through the bioptic telescope, there has been concern that the driver might not see a potential obstacle. This would certainly be an issue if the individual were to be looking through the bioptic all of the time, but as has been discussed, this is not the case. In fact, drivers miss visual information much more frequently and to a greater extent when they adjust the radio, the heater or air conditioner, or use their side or rear-view mirrors. As a result, the ring scotoma concern should not be considered any greater an issue than other normal activities performed while driving.

### ***Focusing***

Bioptics can either be fixed focus, manual focus or autofocus. When users are sighting through the bioptic for driving, they will be looking at distances greater than 20 feet away- a distance at which telescopes are at "optical infinity." At optical infinity everything is in focus from 20 feet and beyond without refocusing. As a result, if the sole purpose of a bioptic device is for driving, a fixed or manual focus device (that could have its focus locked in position if necessary) is all that is required. However, bioptic telescopes have applications beyond driving—in stores, classrooms, at work, while traveling, visiting museums, etc., and these activities are often at distances closer than 20 feet- distances where focusing is necessary. As a result, a visually impaired driver might elect to obtain a manual or autofocus device for the other applications for which it can be useful, while not focusing it while driving.

### ***Who prescribes bioptic telescopes***

Optometrists and ophthalmologists who specialize in low vision care prescribe bioptic telescopes. General eyecare providers usually do not provide such services. In addition to tests to determine the visual acuity response to telescopic devices a prognosis for a successful prescription should include tests for contrast, dominance (especially for one-eyed prescriptions), and dexterity with the use of the device.

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