Progressive Lens Dispensing

MODULE 10

Progressive Lens Candidates

- The best candidates include:
  - Previous progressive lens wearers
  - Emerging presbyopes with a relatively low Add power
  - Individuals highly motivated to wear progressives
- Candidates that may require consideration include:
  - Presbyopes with a relatively high Add power (>+2.25)
  - Previous wide-segment bifocal wearers
  - Individuals sensitive to vertigo or motion sickness
  - Individuals with a significant oculomotor imbalance
  - Individuals particularly sensitive to changes in vision

Fitting Progressive Lenses

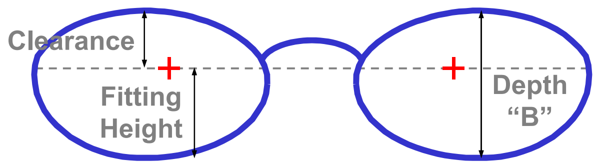
- When fitting progressive lenses, use the following procedure:
  1. Select the frame
  2. Pre-adjust the frame
  3. Measure the fitting heights
  4. Measure the distance PDs
  5. Verify cut-out
  6. Take free-form measurements (if necessary)

1. Select the Frame

- Select a well-fitting frame that maintains its adjustment
- Frames with adjustable nose pad (guard) arms will allow for small fitting height corrections later
- Large aviator-like styles will expose the wearer to regions of distortion that serve no visual purpose
- For most general purpose progressive lenses, a minimum depth of 25 – 30 mm is recommended
- Remain cognizant of the minimum fitting height during the frame selection process

Ideal Frame Geometry

- Ensure that the frame allows for the minimum fitting height of the lens design (e.g., 18 mm)
- Ensure that the frame allows for a sufficient amount of clearance above the fitting cross
- For most general purpose progressive lenses, a minimum depth of 25 – 30 mm is recommended

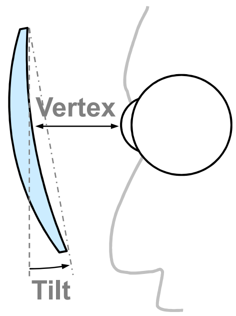


2. Pre-Adjust the Frame

- Ensure a minimal vertex distance
- Ensure at least 7° or more of pantoscopic tilt
- Ensure a sufficient amount of face-form wrap
- Adjust rimless frames with demo lenses in place

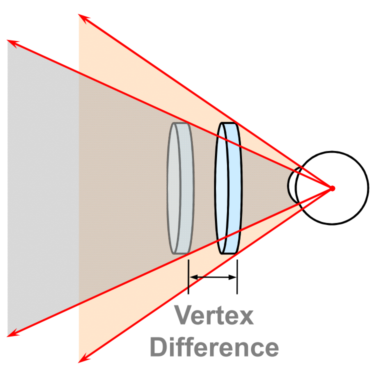
Vertex Distance and Lens Tilt

- *Vertex distance* is the distance from the back vertex of the lens to the cornea
- *Pantoscopic tilt* is the inclination of the bottom of the lens towards the face from a vertical plane



Effect of Vertex Distance

- Shorter vertex distances increase the field of view through the viewing zones of the lens



Effect of Pantoscopic Tilt

- Many modern progressive lenses are optically optimized for a minimum amount of lens tilt
- Additionally, the line of sight must pass through an angle of 20° or more to reach the near zone
- This results in an effective tilt—and an apparent vertical narrowing—of the viewing zone aperture

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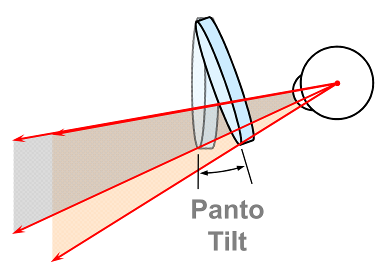
Effect of Pantoscopic Tilt

- Pantoscopic tilt brings the near zone closer to the eye and increases the field of view through the near zone of the lens



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Effect of Pantoscopic Tilt

- Inadequate pantoscopic tilt can reduce the effective size of the near zone

10° Pantoscopic Tilt

No Pantoscopic Tilt

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Effect of Face-Form Wrap

- *Face-form tilt* or *wrap* is the inclination of the temporal edge of each lens towards the face
- Face-form wrap ensures that the frame front follows the natural frontal curvature of the skull
- Face-form wrap brings the peripheral distance zone closer to the eye and increases the field of view through the distance zone of the lens
- This also moves the more troublesome peripheral regions of the progressive lens out of the wearer's immediate field of view

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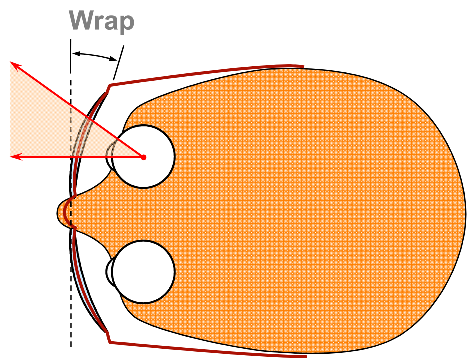
Effect of Face-Form Wrap

- Face-form wrap increases the field of view through the distance zone of the lens



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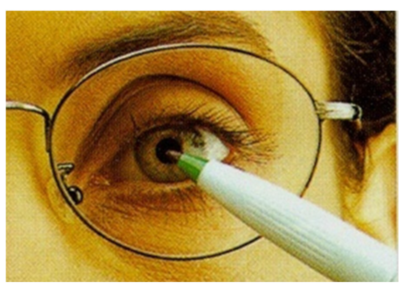
3. Measure the Fitting Heights

- Ensure that you are at eye-level with the wearer
- Take monocular fitting height measurements
- Dot the demo lens, if available
- Measure directly to pupil center



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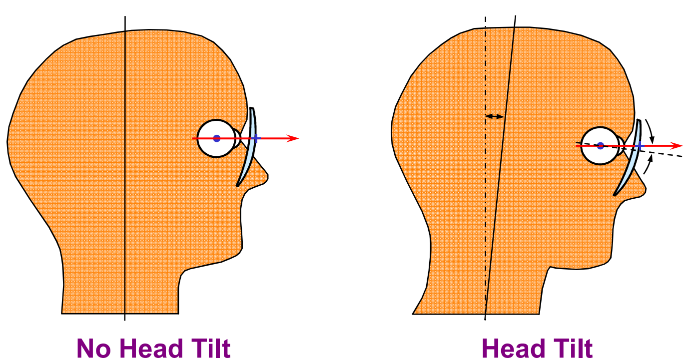
Fitting Heights

- Ensure that the frame is not crooked beforehand
- Ensure that the wearer has assumed his or her natural posture and is looking straight ahead
- If the wearer has worn progressives before, assess the fit of the previous lenses
- Ensure that the measurements are correct after having the wearer move and look around
- If available, use a stand-up mirror to have the wearer verify placement (eliminates parallax)
- Do not “fudge” the fitting height measurement
- Consider slight modifications based upon wearer height or habitual posture when indicated
- Ensure that the minimum fitting height is satisfied

Effect of Wearer Posture

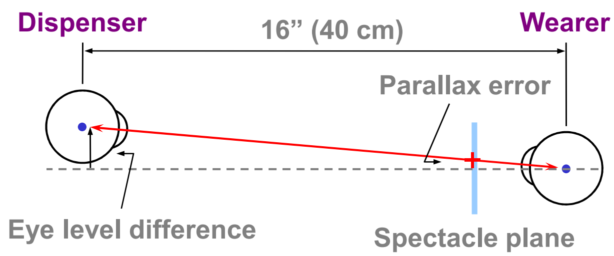
- The wearer should maintain his or her natural or “habitual” posture; any atypical head tilt will result in significant fitting height measurement errors



Effect of Parallax Error

- *Parallax error* can significantly affect fitting height measurements

  1 inch of height difference = 1.7 mm of error



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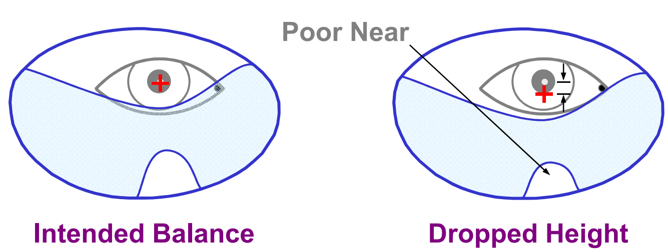
Effect of “Fudging” Fitting Heights

- Dispensers may get into the habit of reducing fitting heights by 1 to 2 mm to improve wearer adaptation
- Wearers are less like to notice *immediately* the effects of poor reading vision compared to poor distance vision
- However, “fudging” the fitting heights in this manner will compromise near vision utility and overall performance



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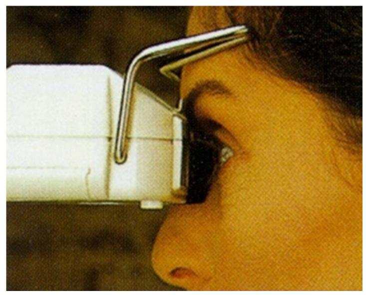
4. Measure the Distance PDs

- Measure the monocular interpupillary distances
- Use a corneal reflex pupilometer for accuracy
- If the wearer has an apparent strabismus (eye deviation), occlude each eye

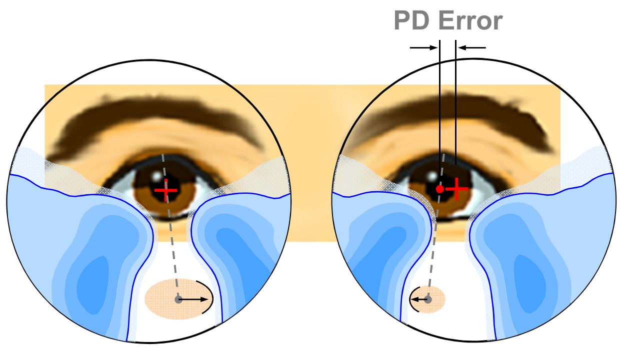


Interpupillary Measurements

- Most manufacturers recommend using the monocular *Distance* PDs, though some dispensers instead add 2.5 mm to the *Near* PDs
  - However, in high powers, using the Near PD can induce prism in the distance portion
  - Many modern progressives use variable insets (not a fixed 2.5 mm), which precludes the need for this compensation
- Incorrect interpupillary distance measurements restrict the apparent fields of usable vision through the lenses
- This also makes it more difficult for the wearer to find the viewing zones of each lens

Effect of Incorrect PD Measurements

- Incorrect interpupillary distance measurements restrict the apparent (binocular) fields of view through the lenses and make it more difficult to find the viewing zones



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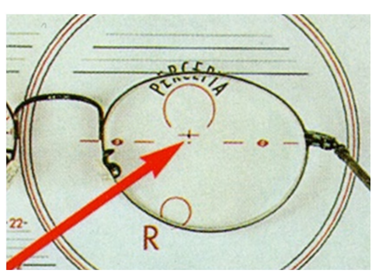
5. Verify Cut-Out

- Use the correct cut-out chart for the lens design
- Place the dotted demo lens on the fitting point of the cut-out chart, and ensure that the frame will cut-out at the desired measurements



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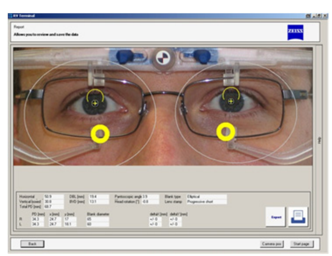
6. Take Free-Form Measurements

- For certain free-form lenses, additional frame fitting measurements can be supplied to further improve optics:
  - Vertex distance
  - Pantoscopic tilt
  - Face-form wrap
- Vertex distance can be measured using a *distometer* or approximated using either a *pupilometer* or a PD ruler
- Pantoscopic tilt should be measured on the wearer from a vertical plane parallel to the face and perpendicular to the line of sight in primary (straight-ahead) gaze
- Face-form wrap can be measured directly from the angle of horizontal lens tilt using a frame wrap protractor chart

Carl Zeiss Vision Measurement Tools

- Carl Zeiss Vision provides an inexpensive tool for measuring pantoscopic tilt and vertex distance (reverse)
- Sophisticated digital centration devices that take extremely accurate measurements are also available

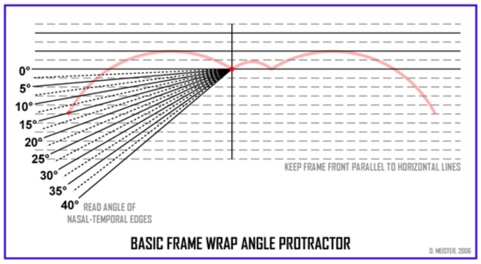
Inexpensive Tool



i.Terminal Screenshot

Frame Wrap Protractor

- Face-form wrap can be measured using a simple frame wrap protractor chart
- Sophisticated digital centration devices can take more accurate measurements

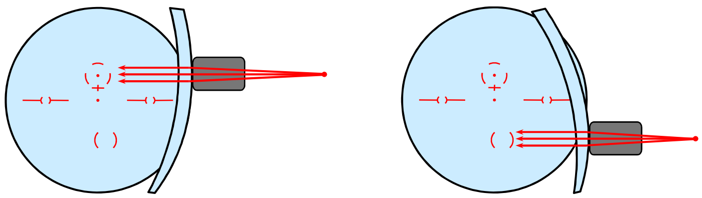


Dispensing Progressive Lenses

- To ensure maximum success with progressive lenses, use the following dispensing procedure:
  1. Verify the Distance prescription, Add power, horizontal axis alignment, and prism of each lens
  2. Re-mark the fitting crosses, if necessary, and verify the vertical and horizontal centration of the lenses
  3. Adjust the frames to ensure a comfortable fit with proper positioning of the fitting crosses
  4. Ensure that the fitting cross of each lens is aligned properly with the pupil center of each eye
  5. Instruct the wearer on the proper use of the lenses

Verifying Semi-Finished Add Power

- For traditional semi-finished progressive lenses *front* vertex power measurements should be used for verifying Add power
- With the front surface of the lens against the lens stop, take the first reading in the distance checking circle and the second reading in the near checking circle

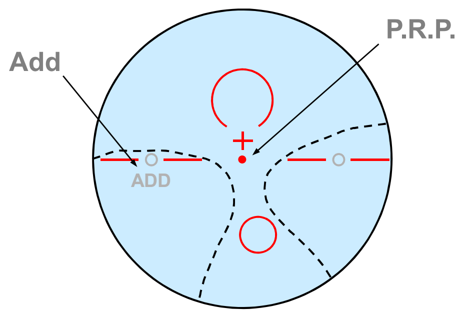


Verifying Add Power

- Due to the nature of progressive lenses, a small amount of "unwanted" cylinder power or a shift in cylinder axis may occur in the near zone, which may affect power readings in some cases
- This may be the result of how the lens are measured, surfaced, or manufactured, though it is generally inconsequential to vision
- Further, depending on the size and fitting height of the edged lens, the full power Addition may be difficult to measure with a focimeter—especially in smaller frames
- Consequently, using the semi-visible Add power engraving is the easiest method to verify Add power

Verifying Prism

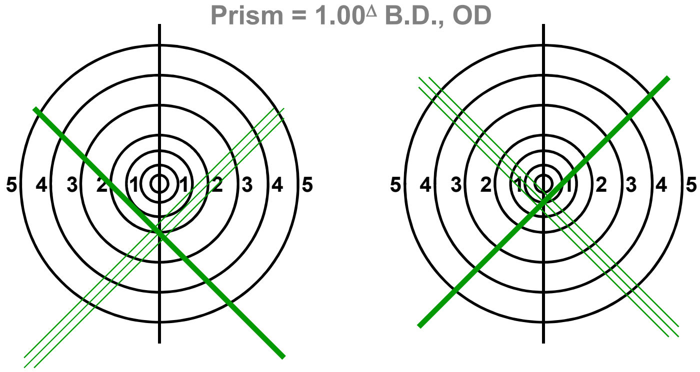
- To verify prism in a progressive lens, measure the prism and prism imbalance at the *prism reference point* (PRP) of each lens



Rx Prism Example – OD: 1.00$^{\Delta}$ B.D.

- Right lens = 2.00$^{\Delta}$ B.D. and Left lens = 1.00$^{\Delta}$ B.D.

Prism = 1.00$^{\Delta}$ B.D., OD



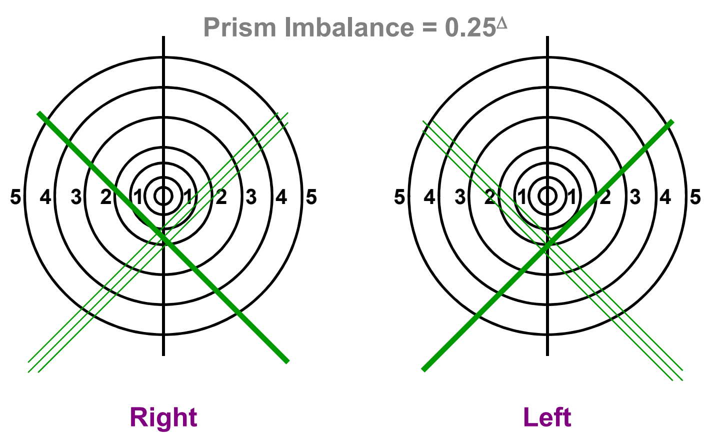
Right Left

Prism-Thinning

- Many progressive lenses are now surfaced using equal amount of vertical prism
- *Prism-thinning* (or *equi-thinning*) reduces the overall thickness and weight of progressive lenses
- "Yoked" prism produces neither a prismatic imbalance nor *vergence* ocular movements
- Prism-thinning usually benefits Plus lenses more than Minus lenses
- As a rule-of-thumb, 2/3rd or 60% of the Add power is surfaced in the form of base down prism
- This prism should be treated as prescribed prism

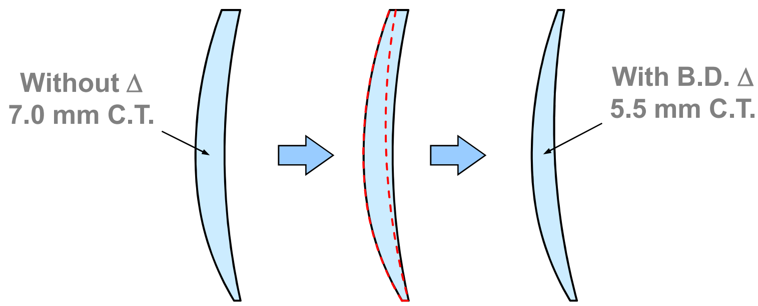
Vertical Prism Imbalance Example

- Right lens = 1.75^{Δ} B.D. and Left lens = 2.00^{Δ} B.D.



Prism-Thinning Comparison

- Prism-thinning is done to reduce the overall and differential thickness of progressive lenses



Adding Base Down Prism to a Progressive Lens Blank

Cylinder at Measurement Points

- Unwanted cylinder in the distance and near checking circles is often due to several factors:
  - The relatively large aperture of typical focimeters picks up the unwanted cylinder surrounding the viewing zones
  - The highly aspheric nature of progressives may result in some cylinder from the casting process
  - Surfacing aberrations can produce unwanted cylinder, particularly in the near zone (e.g., blocking waves)
  - The distance of the checking circles from the optical center increases the effects of prism and tilt
- This is why the ANSI Z80.1-2005 allows greater tolerances on power errors for progressive lenses

Axis Shift with Small Cylinders

- Unwanted cylinder on the front surface or as the result of prism (or tilt) can combine with the prescribed cylinder power, creating a *crossed cylinder* effect
- With low Rx cylinder power, even small amounts of unwanted cylinder can cause a significant shift in axis
- However, this effect is usually small, and inconsequential to vision in most cases
- Example:
  - Unwanted cylinder: +0.09 DC × 44
  - Actual prescription: -1.00 DS -0.25 DC × 180
  - Final net power: -0.95 DS -0.26 DC × 170

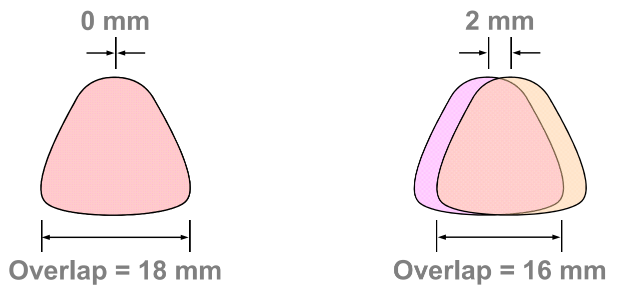
Lens Centration Errors

- Errors in interpupillary distance (lens centration) can cause similar errors in the binocular zone sizes
- For a progressive lens, which has relatively limited viewing zones, this can significantly reduce the usable fields of clear vision
- For a near zone size of 20 mm, a 2 mm total error (the ANSI tolerance) represents a 10% reduction in the apparent binocular field of view
- This error impacts the intermediate zone even more
- Centration errors also make it difficult for the wearer to find the clear viewing zones in each lens

Centration Errors

- Lens centration errors reduce the effective size of the *binocular* viewing zones

1 mm of error = 1 mm binocular reduction



Binocular Near Zone
No Error

Binocular Near Zone
2 mm Error

Instructing the Wearer

- First time wearers will be accustomed to moving their eyes, not their head
- Explain again how the progressive optics work, including the limitations of the peripheral regions
- Describe the horizontal and vertical head movements required for intermediate and near vision (e.g., “point with the chin”)
- Demonstrate the three central viewing zones:
  - Have the wearer practice with a reading card
  - Have the wearer look at a mid-range object
  - Have the wearer look across the room or the street

Prescribing Considerations

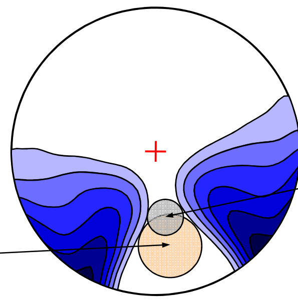
- Prescribe the exact Add power required by the wearer for his or her customary reading distance
  - Bumping the Add power will cause the wearer to read through the progressive corridor
- Prescribe the exact ocular refraction, including the cylinder power and axis required by the wearer
  - Residual astigmatism will distort the viewing zones
- Consider the effects of prescribed prism
  - Adjust the fitting cross positions if necessary
  - Occlude each eye during PD measurements
- For certain free-form progressive lenses, compensated prescriptions may be necessary

When Using Small Frames

- Use progressive lenses that work well in small frames, instead of "bumping the Add"
  - At least one study has shown that more patients prefer the prescribed Add power for progressive addition lenses to the over-plussed Add power
  - Increasing the Add power effectively shifts near vision up from the near zone and into the narrower corridor, as well as increases the level of unwanted blur in the periphery of the lenses
  - A higher Add power also restricts the extended range of clear vision (or *depth of field*) for the wearer
- For fitting heights below 19 or 18 mm, consider lenses specifically designed for small frames

Effect of "Bumping" the Add Power

- *Bumping* the Add power effectively raises the near zone into the narrower progressive corridor, and increases the overall level of blur
- This restricts the field of usable vision through the lens

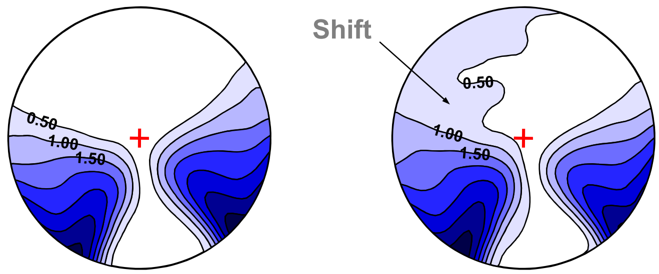


Effect of Prescription Errors

- Residual cylinder errors from uncorrected or improperly corrected ocular astigmatism will interact optically with the surface astigmatism of a progressive lens
- This optical interaction may narrow, distort, or even translate (move) the viewing zones of the progressive lens as the wearer finds other regions of the lens that are "clearer" than the central viewing zones
- Excess Plus power in the distance prescription can exacerbate the blur produced by low levels of unwanted Add power in the vicinity of the distance zone
- Insufficient Plus power can reduce the utility of the near zone during near vision

Effect of Residual Cylinder Error

- Residual cylinder error from uncorrected astigmatism can effectively *narrow* and *translate* the usable zones of the lens for the wearer



Performance of Desired Rx | **Uncorrected Cylinder × 45**

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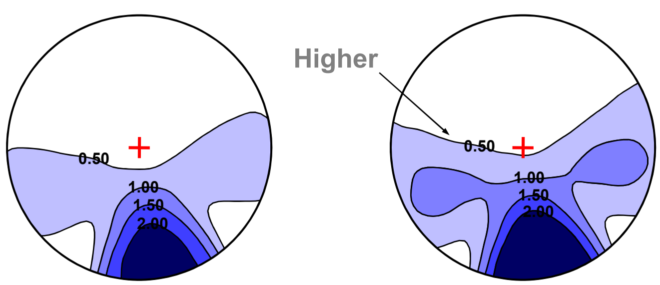
Effect of Over-Plussing

- Excess Plus power can effectively raise the progressive optics further into the distance zone, exacerbating the blur produced in the vicinity of the distance zone



Normal Mean Add Power | **With +0.25 D Of Excess Plus**

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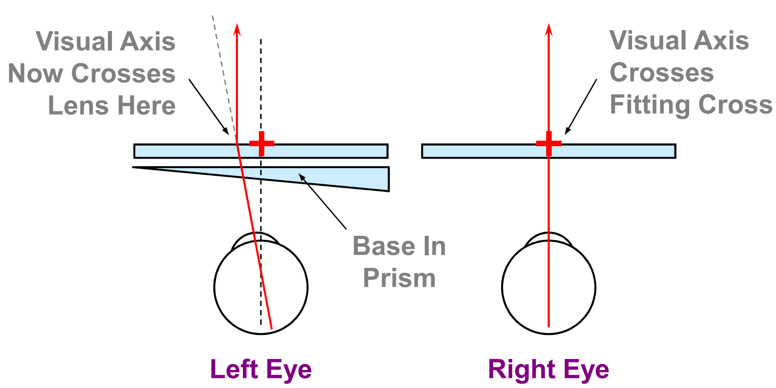
Prescribed Prism

- When fitting progressive lenses on patients with prescribed prism, remember:
  - Progressives may be more difficult to adapt to
  - For patients with *strabismus* (i.e., an obvious turning of one eye), occlude each eye while taking the monocular PD measurements
  - Prism causes the eye to turn, which moves the line of sight across the lens and may necessitate small compensations in fitting cross location
- Significant oculomotor imbalance (e.g., strabismus) may be a contraindication for progressive lens wear

Effect of Prescribed Prism

- Prism shifts the visual axis towards the apex of the prism

Shift fitting cross 0.3 mm for each 1Δ of prism



Position of Wear Optimization

- Many free-form progressive lenses are optimized for the *position of wear*, which represents the position of the fitted spectacle lens on the actual wearer
- Factors such as lens tilt, vertex distance, and oblique viewing angles introduce effective changes to the optical powers of the lens once they are actually worn
- Free-form lens suppliers may compensate for these optical effects in order to ensure that the actual wearer perceives the prescribed powers once the lenses are on
- A *compensated prescription* represents the vertex power that should be used for verification in order to ensure that the wearer experiences the prescribed power

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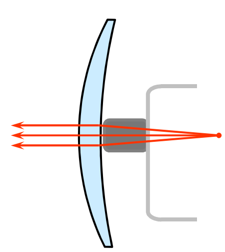
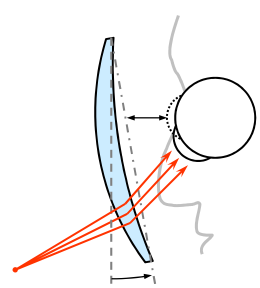
Position of Wear Optimization

- Optimization for the position of wear refines the optics of the basic lens design in order to compensate for the optical effects introduced by the actual fitting geometry



How a *Focimeter* Measures Optics



How the *Wearer* Experiences Optics

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Compensated Prescription Forms

- A typical compensated prescription form shows both the original prescription values and the modified values that must be utilized for power verification using a focimeter

Example:

Desired Rx: +2.00 D sph, +2.00 D Add

THE RX PRESCRIBED:

Sphere	Cyl	Axis	Add	Prism
+2.00			2.00	

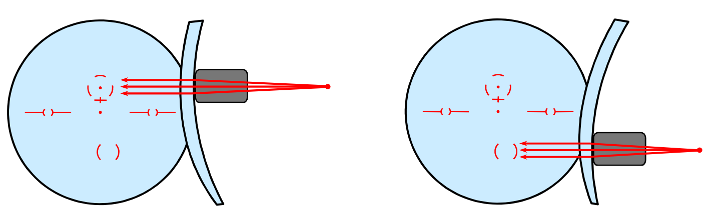
THE RX WILL MEASURE:

Sphere	Cyl	Axis
+2.00	-0.08	000

Mean Add
1.98

Verifying Free-Form Add Power

- For free-form progressive lenses, which often come with a *compensated prescription*, *back* vertex power measurements are often used for verifying Add power
- The measured Add power should be compared to the Add power of the compensated prescription from the lab



First Reading	Second Reading

Progressive Lens Troubleshooting

- When the wearer presents with a complaint pertaining to the vision through progressive lenses, the eyewear should be carefully evaluated:
  - Verify prescription fabrication and Add power
  - Verify prism (both wanted and unwanted)
  - Verify fitting heights to pupil center on the wearer
  - Verify monocular interpupillary distances on the wearer
  - Verify frame adjustment, including tilt, wrap, and vertex
- Ask probing questions of the wearer to ascertain the exact nature of the problem or complaint
- Vague complaints should be clarified (e.g., “I can’t see” may mean “my vision is not as clear at distance”)

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Progressive Lens Troubleshooting

- When assessing the situation, consider these questions:
  - Have the lenses been fitted correctly and has the frame been properly adjusted to maximize performance?
  - Has the wearer been properly trained in the use of progressive lenses?
  - Is the wearer a suitable candidate for progressive lenses?
  - Does the wearer have realistic expectations regarding the performance—and limitations—of progressive lenses?
- Also consider common causal factors:
  - Significant increase in Add power
  - Former wearer of lined bifocals accustomed to a wide near
  - Significant change in design from previous progressives

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Troubleshooting: Distance Vision

- Complaint: “Distance vision is blurred everywhere”
  - Verify that the prescription was fabricated correctly
  - Verify the spectacle refraction (e.g., full cylinder correction)
- Complaint: “Distance vision field is narrow”
  - Verify that the correct Base curve was used
  - Adjust the frame to increase face-form wrap
- Complaint: “Distance vision is blurred when head is erect but clears when chin is lowered”
  - Verify the prescription fabrication and spectacle refraction
  - Verify that the fitting heights are not high
  - Adjust the frame to lower lenses (e.g., widen pad arms)

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Troubleshooting: Intermediate Vision

- Complaint: “Vision at arm’s length (24-36”) is not clear”
  - Verify that the monocular PDs are correct
  - Verify that the fitting heights are not low or high
  - Verify that the Add power has not been over-Plussed
  - Adjust the frame to achieve correct fitting heights
  - Move computer monitor or viewing task to better position
- Complaint: “Field of vision at arm’s length is narrow”
  - Verify that the monocular PDs are correct
  - Verify that the fitting heights are not low or high
  - Adjust the frame to reduce vertex distance
  - Explain that increasing Add power will narrow intermediate

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Troubleshooting: Near Vision

- Complaint: "Reading area is not wide enough"
  - Verify that the fitting heights are not low
  - Verify that the Add power has not been over-Plussed
  - Adjust the frame to raise lenses (e.g., narrow pad arms)
  - Adjust the frame to increase pantoscopic tilt
- Complaint: "Must tilt head back to read correctly"
  - Verify that the prescribed Add power is not weak
  - Verify that the fabricated Add power is not weak
  - Verify that the fitting heights are not low
  - Adjust the frame to raise lenses (e.g., narrow pad arms)
  - Switch to a lens design with a shorter corridor if necessary

Troubleshooting: Binocular Vision

- Complaint: "Field of vision appears off-center when one eye is closed or covered"
  - Verify that the lenses have not been switched eye-for-eye
  - Verify that the monocular PD measurements are all correct
  - Verify that the fitting height measurements are all correct
  - Verify that the lenses are aligned using semi-visible logos
  - Verify that the prescription was fabricated correctly
  - Verify the spectacle refraction, including cylinder axis
  - Verify that there is no unwanted prismatic imbalance
  - Evaluate the patient for any habitual head turn
  - Adjust the frame to ensure a proper fit with good alignment
  - Switch to a lens design with a variable inset if necessary

Troubleshooting: Peripheral Vision

- Complaint: “Objects such as doors or stairs appear to ‘bow,’ ‘rock,’ or ‘swim’ unnaturally in the periphery”
  - Check for significant a change in Base curve
  - Verify that the prescription was fabricated correctly
  - Compare the Add power with previous prescription
  - Adjust the frame to increase pantoscopic tilt
  - Adjust the frame to increase face-form wrap
  - Adjust the frame to reduce vertex distance
  - Adjust the frame to lower lenses (e.g., widen pad arms)
  - Explain progressive optics and adaptation period
  - Switch to a “softer” progressive lens design if necessary

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