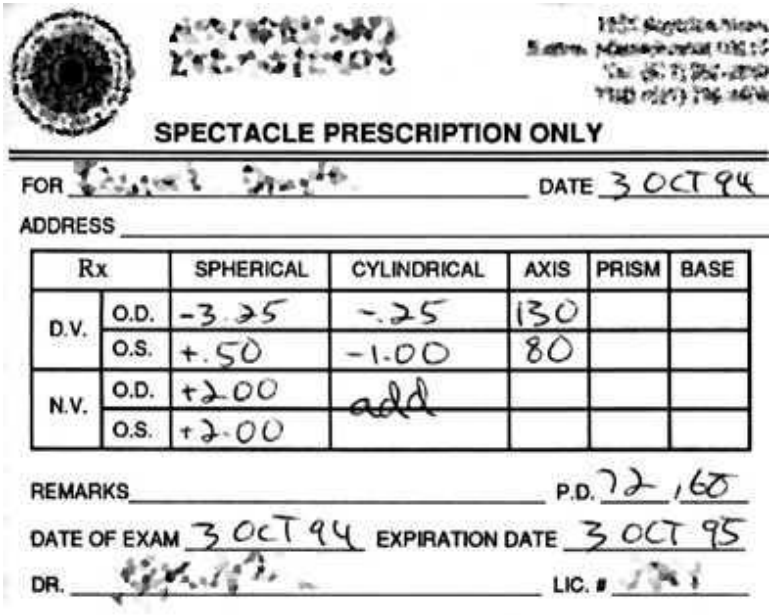
Measurements and Math

Eyeglass prescription

If you've ever looked closely at your eyeglass prescriptions, you've probably wondered how to make sense of all those numbers and symbols. In order to be interpreted worldwide, eyeglass prescriptions are written in a standardized format with standardized notation. Here's a look at a sample eyeglass prescription.



SPECTACLE PRESCRIPTION ONLY

FOR _____ DATE 3 OCT 94

ADDRESS _____

Rx		SPHERICAL	CYLINDRICAL	AXIS	PRISM	BASE
D.V.	O.D.	-3.25	-.25	130		
	O.S.	+.50	-1.00	80		
N.V.	O.D.	+2.00	add			
	O.S.	+2.00				

REMARKS _____ P.D. 72 / 68

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DR. _____ LIC. # _____

The following are the abbreviations you may encounter on your eyeglass prescription:

- **DV** - Distance Vision,
- **NV** - Near Vision
- **Sphere** - Spherical power has the same power in all meridians
- **Cylinder** - A cylinder power corrects astigmatism and represents the difference in the greatest power of the eye and weakest power of the eye, usually separated by 90 degrees.
- **Axis** - indicates the angle (in degrees) between the two meridians of an astigmatic eye
- **PD** - (pupillary distance, or distance between the centers of the two pupils between the eyes) This measurement is essential to designing glasses that are comfortable to wear and optically perfect.
- **Prism** - Prism is not commonly prescribed. It is often prescribed to displace the image in a certain direction for patients with crossed-eye (**strabismus**) or other eye muscle or focusing disorders.
- **Base** – The direction that the Prism is needed for vision correction. (in,out,up,down)

A Lesson in Latin

One must first take a little lesson in Latin to make sense of an eyeglass prescription. Latin abbreviations are often used in health care to write medical prescriptions and eyeglass prescriptions. These abbreviations are becoming less and less common because state and federal rules and regulations are starting to reduce dependence on them.

The letters **OD** indicate the right eye.

The letters **OS** indicate the left eye.

The letters **OU** stand for both eyes.

Numbers, Numbers

Eyeglass prescription powers are written in diopters. In our example above, the first number to the right of OD is -3.25. This is the "sphere" part of the prescription. The sphere number indicates **nearsightedness** or **farsightedness**. Generally, a minus sign (-) indicates a negative-powered lens that is used to correct nearsightedness. A positive sign (+) indicates a positive-powered lens used to correct farsightedness.

The next number in the sample eyeglass prescription is -0.25. This number represents the "cylinder" part of the prescription. Another word for cylinder is **astigmatism** and represents the difference in curvature and power between two points on the eye, separated by 90 degrees. The next number is x 130, read as "axis 130." This number indicates the angle in degrees from 0 to 180, representing the location of the most positive meridian in an eye that has astigmatism when written in minus cylinder form, as in the example above. The OS numbers cover the sphere, cylinder and axis as well.

Finally, the ADD number of +2,00 represents the **power** that needs to be "added" to the distance prescription to give the patient clear vision at a close range for reading and near point activities. This usually indicates that a patient needs a bifocal power as they start to lose their near focusing ability (a problem that commonly begins to develop as we reach our forties.)

As you can see, reading an eyeglass prescription can be confusing. However, with a little study and practice, you'll be able to read prescriptions like the pros.

Source:

Eskridge, J. Boyd, John Amos and Jimmy D. Bartlett. "Clinical Procedures In Optometry." Copyright 1991 by J.B. Lippincott Company. Chapter 18 - "Monocular Subjective Refraction" by Polasky Michael, pp 174-188.

Transposing Prescriptions

Lenses are made in minus cylinder however prescriptions from an ophthalmologist are written in plus cylinder. If you receive a prescription in plus cylinder you will need to convert or transpose the prescription to minus.

Transpose a prescription written in plus cylinder form to minus cylinder form as follows:

1. Add the sphere and cylinder powers to determine the new sphere power.

2. Change the sign of the cylinder. (from plus to minus)

3. Change the axis by 90 degrees. (If the original axis is 90 or less you will add 90 if it is greater than 90 you will subtract 90.

Example:

Transpose -3.00 +2.00 x 30

1. Add the sphere and cylinder powers to determine the new sphere power.

(-3.00) + (+2.00) = -1.00

2. Change the sign of the cylinder

-2.00

3. Change the axis by 90
(30 + 90 = 120)
the transposed prescription is: -1.00 -2.00 x 120

Transpose
OD +1.00 +2.00 x 160 _____ _____ x _____
OS -1.00 +1.00 x 25 _____ _____ x _____

Answer
OD +3.00 -2.00 x070
OS Plano -1.00 x 115

When reviewing a patient's prescription it is important that you can transpose if necessary. You will need an accurate minus cylinder to decide what lens and frame styles will work best for your patient.

Converting a Bi-focal RX to a Reading RX.

A patient may bring in a Bi-focal prescription and request reading only glasses. You will need to be able to accurately convert the prescription so reading glasses can be made. This is a simple process, you just add the bi-focal power (add power) to the Sphere power of the lens. The cylinder and axis if any will remain unchanged.

Example:

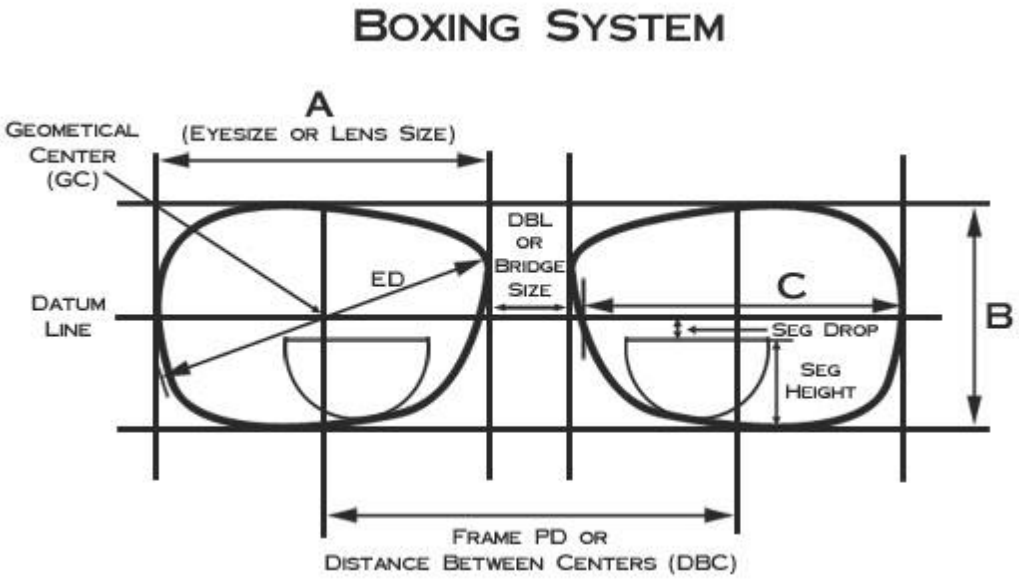
OD -2.00 sph
OS -1.25 -0.50 x 120
Add +2.00ou

The reading RX will be:
OD Plano (-2.00 + +2.00) = Plano
OS +0.75 -0.50 x 120 (-1.25 + +2.00) = +0.75

Remember reading glasses are also made in minus cylinder so if your Bi-focal prescription is written in a plus cylinder you will first need to transpose to minus cylinder BEFORE adding the Bi-focal power to the Sphere power.

The Boxing System

In 1962 the Optical Manufacturers Association adopted the **boxing system** to provide a standard for frame and lens measurement that greatly improved upon the accuracy of previous systems. The boxing system is based upon the idea of drawing an imaginary box around a lens shape with the box's side's tangent to the outer most edges of the shape. The system uses the sides of the boxes as reference points for the standard system of measurements.



"A" Measurement - The horizontal distance between the furthest temporal and nasal edges of the lens shape or the distance between the vertical sides of the box. The A measurement is also commonly known as the **eye size**.

"B" Measurement - The vertical distance between the furthest top and bottom edges of the lens shape or the distance between the horizontal sides of the box.

Effective Diameter (ED) - Twice the distance from the geometric center of the lens furthest edge of the lens shape. The ED can also be defined as the smallest diameter lens that would cutout, if the frame's geometric center matched the lenses optical center. ED is used in combination with decent ration distance to select the minimum lens blank size required to fit a given frame.

Distance Between Lenses (DBL) - The shortest distance between the nasal edges of each lens or the distance between boxes. DBL is also commonly referred to as **bridge size**.

Datum Line - The horizontal line that runs through the vertical center of the frame.

Geometric Center (GC) - The intersection of the Datum Line and horizontal centers of each lens shape.

Distance Between Centers (DBC) - The horizontal distance between the geometric centers of the lenses. DBC is also known as the **Geometric Center Distance (GCD)**, but more commonly referred to as the **frame PD**. In theory the DBC can be calculated by adding the "A" Measurement to the DBL as marked on the frame, however in practice the calculation may differ from the actual measurement.

Note: Frames are typically marked for size, for example: 54-18, where 54 is the "A" Measurement and 18 is the DBL.

Seg Height - The vertical distance between the bottom edge of the box and the top of the bifocal or trifocal segment

Seg Drop - The vertical distance between the Datum line and the top of the bifocal or trifocal segment Overall

Temple Length (OTL) - The running distance between the middle of the center barrel screw hole and the end of the temple.

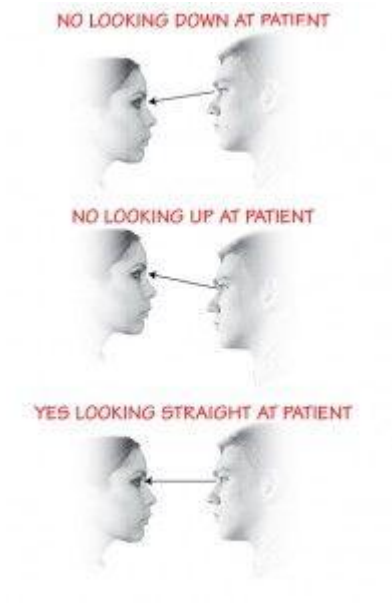
Length to Bend (LTB) - The distance between the center of the barrel and the middle of the temple bend.

Front to Bend (FTB) - The distance between the plane of the front of the frame and the temple bend. Used if there is a significant distance between the frame front and the beginning of the temple

Measure a Bifocal Lens

If a patient is currently wearing bifocals, ask the following questions:
• Do you experience any problems seeing with your bifocals?
• Do you have to tilt your head back to read?
• Do you have to lower your chin to see objects in the distance?
• Are you having any problems easily seeing objects 2-3 feet away?
• Do you use a computer?
Based on the responses, you will determine whether you need to raise or lower the patient's current bifocal height. Or you may determine that bifocal lenses are not the best solution for this patient.

If a patient is satisfied with their current bifocal height, mark the new bifocal at the same height in relation to the patient's face (i.e. lower lid margin, bottom of lashes). Make sure the new marks are in same area as the old bi-focal. Make sure the patients frame is fitting properly and then make sure to fit the new frame to the patient before measuring. If it is a first-time bifocal wearer, the bifocal segment should be marked at the lower lid.

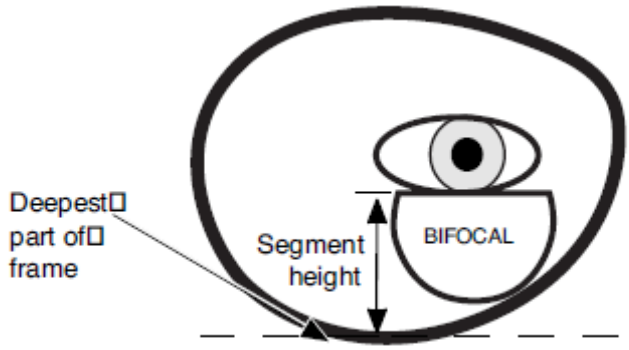


TIP: Always be sure that you are looking straight at the patient whenever you are taking a measurement, being higher or lower will affect the results.

After marking, remove the glasses and place a piece of tape (yellow sticky) on the marked area to represent where the Bi-focal will sit on the new glasses. Then give the patient back the glasses and have them set back in their normal posture (in most cases the patient will elevate their chin and this could change where to place the bi-focal) have them look out to see if they can see over the bi-focal (yellow sticky) .If the patient is not happy where the Bi-focal will set just remove the tape and re-measure. Once the tape is sitting in a good spot for the patient remove the glasses and measure from the top of the tape. Always measure from the top of the bifocal lens (or tape) to the **deepest** part of the frame regardless where the eye sits in the frame. The actual measurement, in millimeters, will be different for different frames.

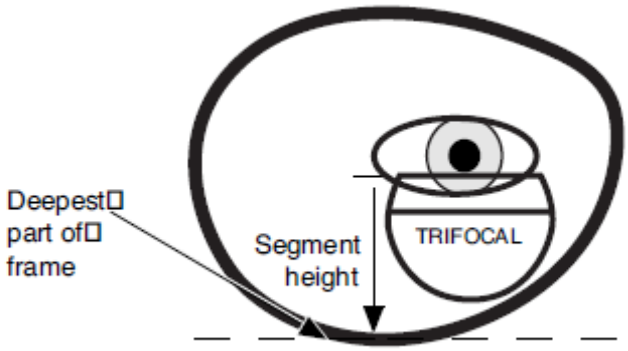
Example

Correct measurement:



Measure a Trifocal Lens

When measuring for a trifocal lens, follow the same steps as for a bifocal lens. Measure from the top of the trifocal to the deepest portion of the lens.



If this is the patient's first trifocal, mark and measure 3 mm below the center of the pupil to the deepest part of the lens.

Segment Placement

Notice the natural head position of the patient while seated and standing.
Make certain you are at eye level with the patient.

Current Wearers

Be observant!
Look at the patient's spectacles.
What type of lenses are they wearing?
Where are the bifocal or trifocal segments in relation to a reference point of the patient's pupils, eyelids, or facial features?

Placement

Remember the current segment placement.
Place the adjusted frame on the patient.
Verify the placement as compared to the patient's old eyewear.
The new segment should be positioned using the same reference point.

Measurement

Mark with tape where the Tri-focal line will start have the patient put the glasses back on and if the patient is comfortable with the height then, remove the frames and, using a PD ruler, measure from the top of the tape to the deepest point of the lens.

Progressive lenses

Whenever you are measuring a progressive lens it is very important that you start by taking a monocular PD measurement by using the pupilometer. The channels for the progressive must be directly under the optical centers; these exact measurements can only be done using the pupilometer. Example the below shows OD 30 and OS 31.5.

Most progressive fitting heights will be more than half of the frame B and will usually fall between 15 and 25 millimeters from the bottom of the eye wire.

1. Place yourself across from the patient and at the exact same height as the patient.
2. If the patient has worn progressive lenses before, ask them specifically if they have had problems in the past with a segment being too high or too low.
3. Adjust the frame so that it sits correctly on the patient's nose is in the position the patient prefers. Explain the importance of this. Say, "I need you to position the frame exactly where you like to wear it, so I can mark where the progressive will start."
4. With the patient's head in a relaxed position and looking straight at you, on the demo-lens dot the very center of their pupil. This is where the distance area of the progressive lens will be placed.
5. Remove the glasses and measure from the lowest point of the eye wire to the dot. Record the measurement on your lab order form as the fitting height, or "fit" height.

(Parts of measurements section taken from www.opticianworks.com)