National Academy of Opticianry

Continuing Education Course

Approved by the American Board of Opticianry

Types of Lenses –
Converting Bifocal Rxs to Task Specific Rxs

National Academy of Opticianry
8401 Corporate Drive, #605
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National Academy of Opticianry

PREFACE:

This continuing education course was prepared under the auspices of the National Academy of Opticianry and is designed to be convenient, cost effective and practical for the Optician.

The skills and knowledge required to practice the profession of Opticianry will continue to change in the future as advances in technology are applied to the eye care specialty. Higher rates of obsolescence will result in an increased tempo of change as well as knowledge to meet these changes. The National Academy of Opticianry recognizes the need to provide a Continuing Education Program for all Opticians. This course has been developed as a part of the overall program to enable Opticians to develop and improve their technical knowledge and skills in their chosen profession.

The National Academy of Opticianry

INSTRUCTIONS:

Read and study the material. After you feel that you understand the material thoroughly take the test following the instructions given at the beginning of the test. Upon completion of the test, mail the answer sheet to the National Academy of Opticianry, 8401 Corporate Drive, Suite 605, Landover, Maryland 20785 or fax it to 301-577-3880. Be sure you complete the evaluation form on the answer sheet. Please allow two weeks for the grading and a reply.

CREDITS:

The American Board of Opticianry has approved this course for One (1) Continuing Education Credit toward certification renewal. To earn this credit, you must achieve a grade of 80% or higher on the test. The Academy will notify all test takers of their score and mail the credit certificate to those who pass. You must mail the appropriate section of the credit certificate to the ABO and/or your state licensing board to renew your certification/licensure. One portion is to be retained for your records.

AUTHOR:

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INTENDED AUDIENCE:

This course is intended for opticians of all levels.

COURSE DESCRIPTION

This course will introduce types of lenses and will also discuss how to transpose a prescription as well as how to convert a bifocal prescription to a task-specific prescription. Included will be how to place the prescription on an optical cross in order to visualize the finished product.

LEARNING OBJECTIVES

- At the completion of this course, the participant should be able to:

  - Recognize various lens types and categories
  - Identify the powers on the surfaces of lenses
  - Analyze and interpret a prescription
  - Transpose a prescription
  - Have a better understanding of the optical lens cross
  - Be able to convert a bifocal prescription to a task-specific prescription
  - Visualize the final product

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Types of Lenses
Converting Bifocal Rx's to Task Specific Rx's

Diane F. Drake, LDO, ABOM, NCLEM, FNAO

Categories of Lenses

- Sphere
  - Plus
  - Minus
- Compound
  - Sphere & Cylinder
  - Sphero-cylinder

To begin our discussion on transposing and converting prescriptions to task-specific lenses, we must first discuss the different category of lenses. For simplicity purposes, lenses are divided into two categories, sphere and compound also referred to as sphero-cylinder lenses. That means that there is both a spherical power and a cylinder power in the lens.

Spherical Lenses

Spherical (sphere) lenses are lenses with a single dioptric value and have the same curvature in all meridians. We will be discussing the meridians throughout this section and will primarily be discussing the principle meridians. Principle meridians are those meridians that contain the most power and the least power and are 90º apart. In generating (surfacing) spherical lenses, there is only one curvature (power) on the front surface of the lens and one curvature (power) on the back surface of the lens. The algebraic combination of the two powers results in the total power of the lens. For example, if the power of the front surface was +6.00 and the power on the back surface was -4.00, the resultant power would be +2.00. A spherical lens will produce a single point of focus.

Plus spherical lenses are convex lens. The "+" sign is used in front of the power. It usually indicates the patient is hyperopic (farsighted) or the prescription is used for near viewing, however, not all of the time.

Minus spherical lenses are concave lens. The "-" sign is used in front of the power. It usually indicates the patient is myopic (nearsighted) or the prescription is used for distant viewing, however, not all of the time.

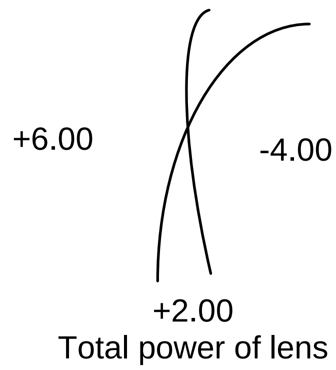
When writing the prescription out, the writer (prescriber) may follow the power with either the designation Sphere, Sph. or D. S., which indicates Diopter Sphere indicating there is NO cylinder power. Actually, this is a very good way of preventing questions in the mind of the person reading the prescription as to whether the Rx is missing cylinder information.

Example:

OD +2.00 D.S.

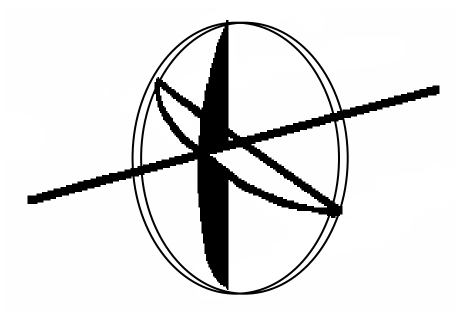
Or

OD +2.00 SPH



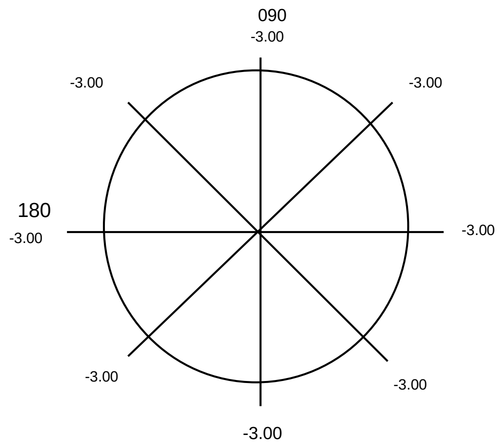
Meridians of a lens

The orientation of powers (curves) on the surface of the lenses are the meridians. They may be measured with a lens clock. As just mentioned, if there is only one power on the front and one power on the back surface, the result is a sphere power lens.



Sphere and Cylinder

As just mentioned, spherical lenses contain the same power throughout the lens (in all meridians). That means that in reading the lens in a focimeter, which is also referred to as a lensometer, vertometer, lens meter, by different manufacturers, the power will read the same and clearly no matter where the axis drum is positioned. However, one must remember the position of the optical center, but that’s another subject to be discussed later.



Lensometer Readings

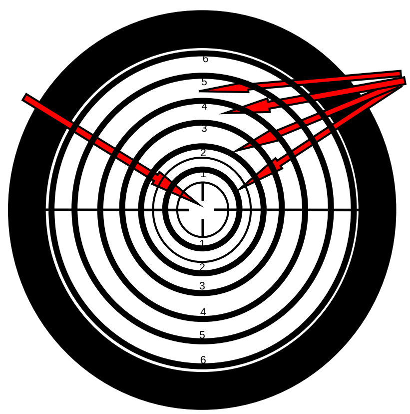
Although this is not a course in lensometry, I want to introduce some now, so that you will understand the powers a little more fully and also understand transposition.

What we will be discussing first will be the reticule, the target, the sphere mires (lines) and the cylinder mires (lines).

Reticule

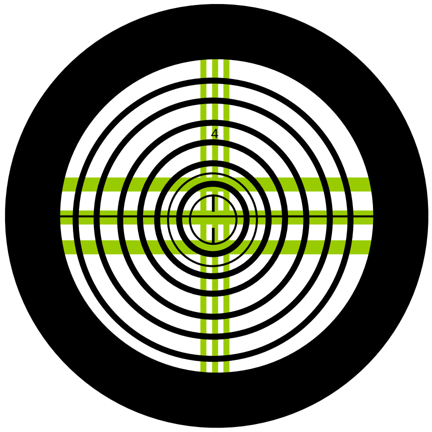
The reticule is made up of crosshairs to assist in locating the optical center of the lens.

The numbered circles are used to determine prism. Each numbered circle represents one diopter of prism



The Target

The target is made up of sphere mires (the small lines) and cylinder mires (the larger lines). The target is able to spin 360 degrees. It is turned with the axis wheel (drum). The axis wheel only shows 0 to 180 degrees.

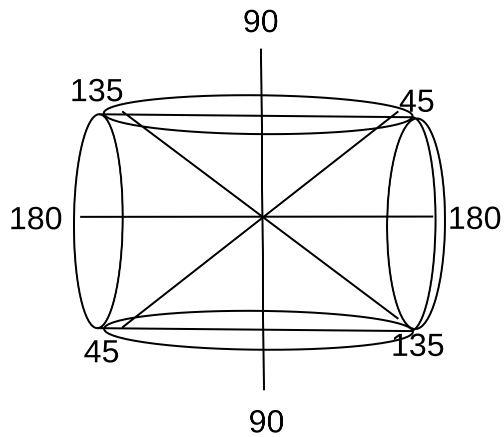


Sphere

In reading (neutralizing) the power of a sphere lens in a focimeter (lensometer, vertometer, lens meter), both the sphere lines (small lines) and the cylinder lines (larger lines) will come into focus at the same time. There will also be no break in the lines.   Once the lines (mires) are completely in focus rotating the axis wheel (drum) will not affect the clarity of the mires.

Cylinder - Compound

Cylinder in a lens is used to correct a condition called astigmatism. They are also referred to as compound lenses or sphero-cylinder lenses, containing both sphere and cylinder power. Cylinder lenses contain surfaces that are more like a football which has a long curve and a short curve. The cylinder meridian on a lens is always more curved since it is added to the sphere.

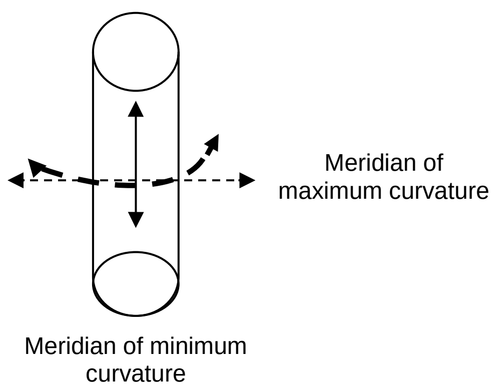


Compound lenses can be a combination of two plus powers, two minus powers, one of each power, a plano, and a plus power, or a plano and a minus power. These also represent the 5 different types of astigmatism that we will be discussing in a later module.

A compound lens will have unequal curvature in its meridians. There will also be an axis.

Cylindrical Lenses

Sometimes in order to understand a cylindrical lens, one can use a cylindrical tube or can to understand. If cut off the top of a can, the top would have the same curvature in all meridians so it would be a sphere. If, on the other hand, you were to slice off a section of the can on the side and look at the curvature, you would find a steeper curve in one meridian and a flatter curve in the opposite meridian.



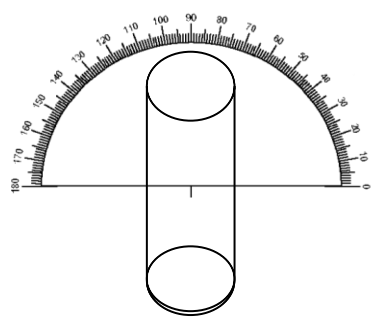
The following example demonstrates a compound prescription containing both plus and minus power.

-2.00 + 2.50 X 180

In the example -2.00 + 2.50 X 180 you can visualize the orientation of the cylinder by placing it over a protractor. The protractor indicates the axis alignment from 0 to 180, with 0 being the 180-degree meridian as well. Ok, now since only the sphere power is located at the axis meridian, which is 180^{o}, place that power on that meridian. Remember the sphere power is still everywhere, but with a compound lens power; it combines with the other power in different meridians of the lens. The full cylinder power is located at 90^{o} away from the axis, so combine the two powers… (-2.00) + (+2.50) = +0.50…so the power at the 90^{o} meridian is +0.50.

90^{o} + 0.50

180^{o} – 2.00



Plus Cylinder or Minus Cylinder

Plus cylinder lenses used to have the cylinder surfaced on the front side of the lens, while, a minus cylinder lens used to have the cylinder surfaced on the back side of the lens. Although, when the lens was placed in a lensometer, you could read the prescription in either plus cylinder or minus cylinder. It was common to order them as such from the lab as such. As a matter of fact, it was difficult if a patient was used to having plus cylinder lenses be able to adjust to minus cylinder, although as front surface cylinder became more and more difficult to obtain, due to tooling in the labs, they had to make the switch.

Now, the cylinder is surfaced on the back surface of the lens, as it allows for better visual properties. With that being stated, let’s begin our discussion of transposition.

Transposition
"The Definition"

Transposition - An algebraic change in writing a spectacle lens prescription giving equal optical performance but specifying the cylinder form in opposite sign and axis rotation of 90º; the converting of a prescription written in minus (-) cylinder form to plus (+) cylinder form, or vice versa.

Terms

OD – Latin for Ocular Dexter - Right eye

OS – Latin for Ocular Sinister - Left eye

OU – Latin for Oculus Uterque or Oculi Uterque - Both Eyes

PD – Pupillary Distance

- Pupillary distance is the horizontal linear measurement in millimeters between the reflexes on the visual axes of the two eyes.
- It is more correctly referred to as interpupillary distance
- It should be measured for distant, intermediate and near positions, monocularly, which means each eye independently.

Diopters

Diopter is the positive or negative optical unit of measurement, the reciprocal of the secondary focal length in meters, used to express the power of a lens. A one diopter lens will displace parallel light rays 1 cm at a distance of 1 meter.

In more simple terminology, the diopter is the unit of measure used to determine the power of lenses. When discussing the anatomy & physiology of the eye, we use diopters to discuss the power of ocular structures. But for now, let's just think of lenses.

The symbol D is used to designate the diopter.

Analyzing and Interpreting a Prescription

In analyzing and interpreting a prescription, we first have to answer several questions. First of all, what is the prescription formula? Then what is the intended use of the eyewear. As eyecare professionals, we need to be sure that we meet the 3 F's; Fit, Function, and Fashion. Be sure to ask enough questions to ensure that you understand the intended use. This is called lifestyle dispensing.

The Prescription

Prescriptions come in all types. This is a fairly typical prescription that you may receive from the patient. It indicates that the patient is myopic (nearsighted), with astigmatism.

Lens	Sphere	Cylinder	Axis	Prism
OD	-2.25	-1.50	180	
OS	-3.00	-1.50	180	

Optical Cross

There are a number of uses for an optical cross. The purpose that we will use here is to identify the powers on a lens in its two principle meridians. An optical cross is a graphic depiction that illustrates the powers of a lens in the two principle meridians, which, on a lens are surfaced 90° apart. In order to understand exactly how a prescription relates to the lens, and how it will make the finished product look, we need to place it on an optical cross, which is sometimes referred to as a lens cross.

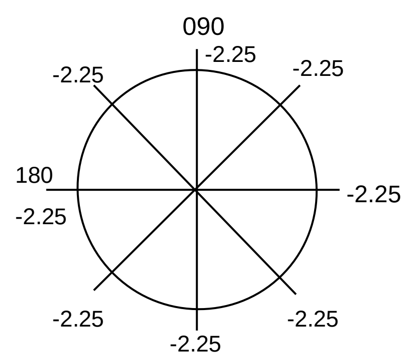
Let's place this prescription on an optical cross.

OD – 2.25 – 1.50 X 180

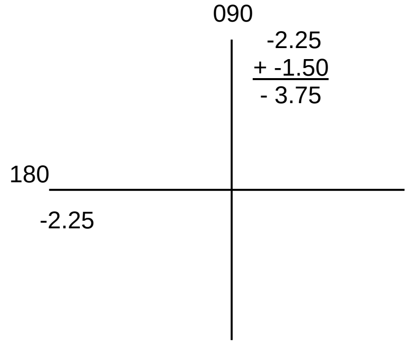
The sphere relates to the axis, although the sphere power is throughout the lens. So the power at the 180^{th} meridian is -2.25D. In the meridian of the axis, there is NO cylinder power.

The cylinder power is at 100% of its power 90 degrees away from the axis and is combined with the sphere power which is also in that meridian. In this example, the sphere power is -2.25D and the cylinder power is -1.50, which combined becomes -3.75. So the power in the 90^{th} meridian is -3.75D.

Let's look at it another way. As illustrated earlier, the sphere power is throughout the lens, so it's everywhere. The sphere power of -2.25D is throughout the lens.



In a lens that also contains a cylinder; the only place that just the sphere power is located is at the meridian of the axis, which in this example is the 180th meridian.
90 degrees away, the full power of the cylinder is added to the sphere power.
So the power at the 90th meridian is the combination of the sphere power of -2.25 plus the cylinder power of -1.50 which equals -3.75D.



Types of Astigmatism

Compound Myopic Astigmatism

-2.25 -1.50 X 180

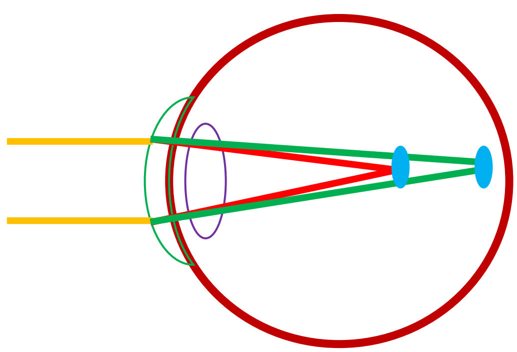
The Rx above is an example of refractive error that is Compound Myopic Astigmatism

Total powers in both principle meridians are in minus power form on the lens cross.

That means that both principle points of focus are in front of the retina.

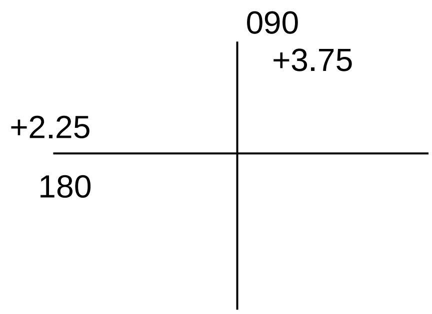
In compound myopic astigmatism, there will always be minus powers in both principal meridians if placed on a lens cross.

Compound myopic astigmatism occurs when both principal meridians focus an image line in front of the retina and are 90° apart.

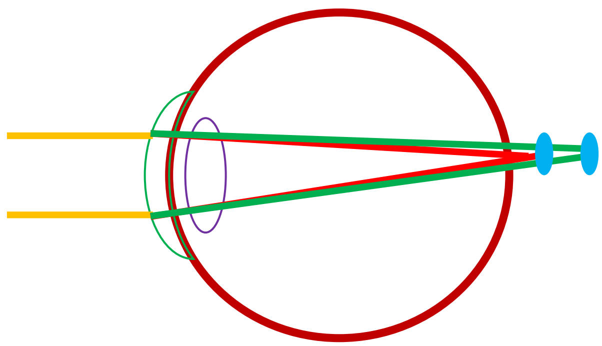


Compound Hyperopic Astigmatism

An example of a prescription of compound hyperopic astigmatism is +2.25 + 1.50 X 180.
In compound hyperopic astigmatism, there will always be plus powers in both principal meridians if placed on a lens cross.



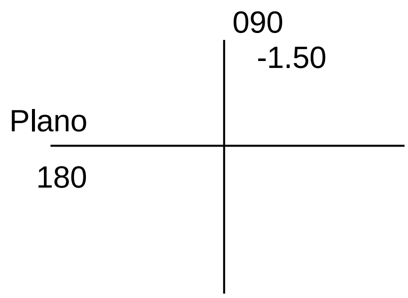
Compound Hyperopic astigmatism occurs when both principal meridians focus an image line in behind the retina and are 90^{o} apart.



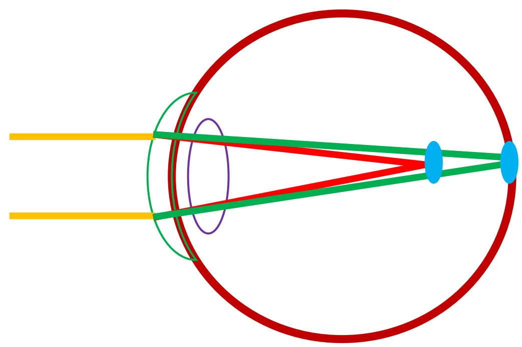
Simple Myopic Astigmatism

Simple myopic astigmatism occurs with the power in one principle meridian would be plano and the power in the opposite meridian would be a minus power. An example of a prescription demonstrating simple myopic astigmatism would be:

Plano – 1.50 X 180



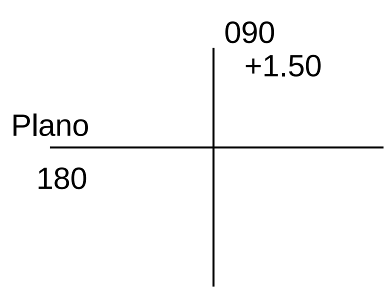
Simple myopic astigmatism occurs when the image in one meridian focuses in front of the retina and the image in the opposite principal meridian focuses on the retina and they are 90º apart.



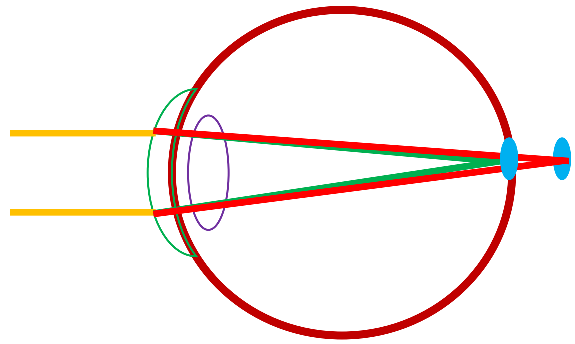
Simple Hyperopic Astigmatism

Simple hyperopic astigmatism occurs with the power in one principle meridian would be plano and the power in the opposite meridian would be a plus power. An example of a prescription demonstrating simple hyperopic astigmatism would be:

Plano + 1.50 X 180



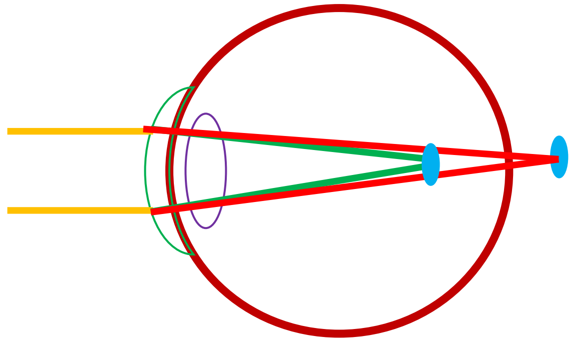
Simple hyperopic astigmatism occurs when the image in one meridian focuses behind the retina and the image in the opposite principal meridian focuses on the retina and they are 90^{o} apart.



Mixed Astigmatism

Mixed astigmatism occurs when the power in one principle meridian is plus and the power in the opposite meridian is a minus power. An example of a prescription demonstrating mixed astigmatism would be:

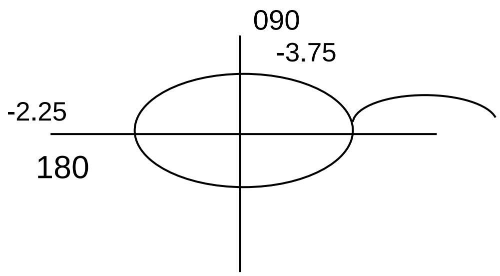
+1.00 – 2.25 X 180



Lens Cross

OD -2.25 -1.50 X 180

In order to visualize how the prescription will look in glasses, simply draw an oval, square or circle around the lens cross and that becomes the lens.
Now you can see where the thickness will be and where it will be thinner. You can also determine if you could improve on the cosmetic appearance of the eyewear by changing lens shape, lens design…i.e. Aspheric lenses, or lens material…high index, etc.



Transposition

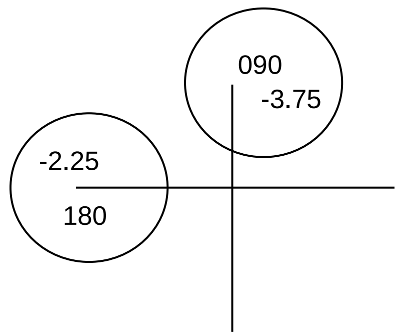
It's important to remember that transposition doesn't change the value of the lens; it simply changes the form in which the prescription is written.

Remember the lens cross???

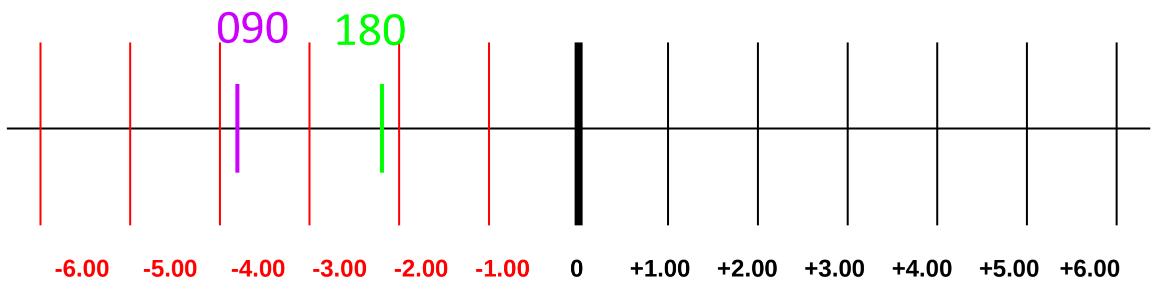
Regardless of whether the Rx is written in + cylinder or – cylinder the powers remain the same in any meridian on the lens cross. This prescription can be written:

-2.25 – 1.50 X 180 or
-3.75 + 1.50 X 090

It's the same lens.



Using the number line as though it were on a lens meter, take the same prescription and orient it here. If you rotate the axis wheel to 180 meridians, the sphere lines will come clear at -2.25 and 90 degrees away at the 90 meridian the cylinder lines will be clear at -3.75.



-2.25 -1.50 X 180

When discussing changing a prescription that is written in plus cylinder form to minus cylinder form, we use the term Flat Transposition, or as it has been more commonly shortened Transposition.

This changes the format without changing the value of the prescription.

Designation of Axis in Rx

When observing the written form of the prescription you may observe that it can be written with the axis as cx.

-2.25 – 1.50 cx 180 or
-3.75 + 1.50 cx 090

Or you may observe that it is written with the axis reference as simply X or x.

-2.25 – 1.50 X 180 or
-3.75 + 1.50 X 090

Flat Transposition

Prescriptions can be written in both plus and minus cylinder form.

-2.25 – 1.50 X 180 or
-3.75 + 1.50 X 090

-2.25 – 1.50 cx 180

To Transpose

Step 1

Algebraically add the cylinder power to the sphere power. This becomes the new sphere power.

(-2.25)+(-1.50) = -3.75

The new sphere power is -3.75

Step 2

Change the sign of the cylinder power to the opposite sign; if it's plus, change it to minus and if it's minus, change it to plus. The numerical power remains the same.

-1.50 becomes +1.50

The new cylinder is +1.50

Step 3

If the axis is 091 to 180, subtract 90 from the axis. If the axis is 001 to 90, add 90 to the axis. The axis is 180, so we subtract 090 and get 090. The new axis is 090 or 90. It is best to use three digits as that ensures that you haven't simply left something off.

It's that simple

-2.25 –1.50 X180 transposed becomes

-3.75 +1.50 X 090

The Prescription

-2.25 – 1.50 cx 180
-3.75 + 1.50 cx 090

OR

-2.25 – 1.50 X 180
-3.75 + 1.50 X 090

When writing an Rx containing an axis, by substituting either cx or X, you routinely drop the degree symbol. This helps to reduce the error of confusing it with a zero (0).

Types of Lenses

Single Vision
Bifocal
Trifocal
Progressive Addition Lenses
Specialty
- Occupational
- Sports
- Any type of task-specific lenses

Single Vision

Single vision lenses are used to correct only one type of visual error at one distance. They produce a single point of focus. They can be either plus, minus or compound lenses.

Bifocal Lenses

This is the same distant prescription just demonstrated, but with the addition of a bifocal add power.

Lens	Sphere	Cylinder	Axis	Prism
OD	-2.25	-1.50	180	
OS	-3.00	-1.50	180	
ADD OU	+2.25			

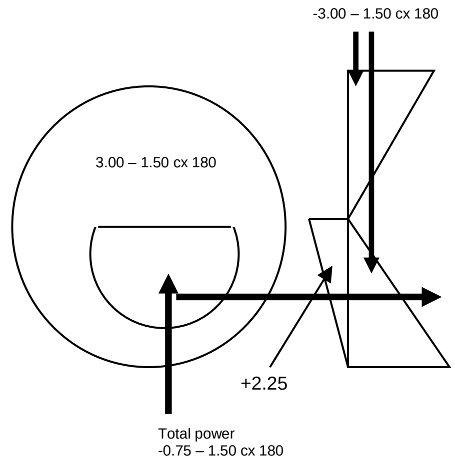
In order to convert a bifocal prescription to a simple reading prescription, you simply add the ADD power to the spherical component of the distant Rx. Leave the cylinder and the axis alone.

The near vision prescription for this Rx becomes:

OD -   Plano – 1.50 cx 180

OS -   -0.75 – 1.50 cx 180

The add power combined with the distant power gives the total power to be used at near.



Although you may think in terms of minus power being for distant correction, please keep in mind that sometimes it is not…as in the example that we just discussed.

That's why it's so important to get a good lifestyle history and observe the Rx.

With the Rx as written, let's suppose that the patient wants near vision only.

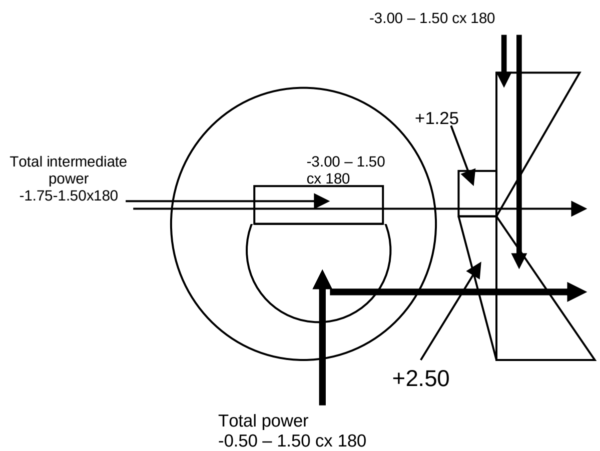
Reading Power

The normal near viewing distance for the average patient is computed for 16 – 18 inches away or approximately 40 cm away. If you need to design task-specific eyewear for your patient at a different level, you will need to determine the distance and calculate the power accordingly.

Trifocal/Intermediate Power

The power of the intermediate portion of a standard trifocal is ½ of the power of the total add power. If the ADD power of an Rx is +2.50. The add power within the trifocal area is +1.25.

Intermediate power is usually for arm's length or approximately 3 feet away.



Trifocal/Intermediate Power

Given this information, if you wanted to create a pair of glasses that would be utilized for intermediate use, you would simply add ½ of the total add power to the distant component of the Rx. Remember that you only add the power to the spherical component and leave the cylinder and axis the same.

This bifocal prescription

OD -2.25 -1.50 cx 180
OS -3.00 -1.50 cx 180

ADD OU +2.50

Becomes this Intermediate Power

OD -1.00 – 1.50 cx 180
OS -1.75 – 1.50 cx 180

Distant and Intermediate Power

Say for a moment that your patient is a pianist and needs to see music about 3 feet away. She also needs to see the conductor at a normal distance for distant power. She is bothered by trifocals and wants bifocals. Simply make bifocals rather than trifocals, by using the intermediate add power for the bifocal add power.

Using the same prescription as above, you would simply order it with a +1.25 add power. You would also need to reaffirm that the patient understands that near viewing would be compromised (not clear).

OD -2.25 -1.50 cx 180
OS -3.00 -1.50 cx 180

ADD OU +1.25

Analyzing & Interpreting the Prescription

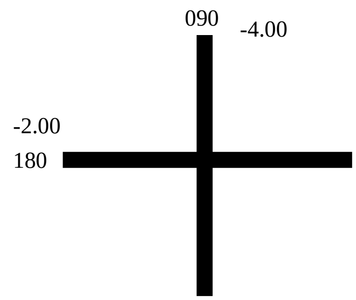
First of all – look at the Rx.

OU -2.00 – 2.00 X 180

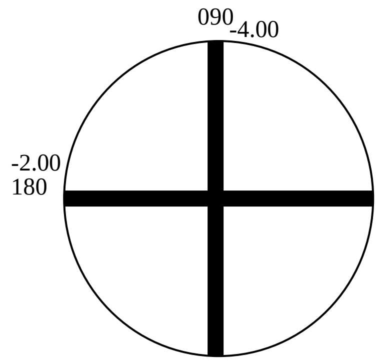
Find out the intended use of the eyewear. Next, you need to be able to identify any potential visual or cosmetic concerns.

Discuss any concerns with the patient. They want to know how they will look.

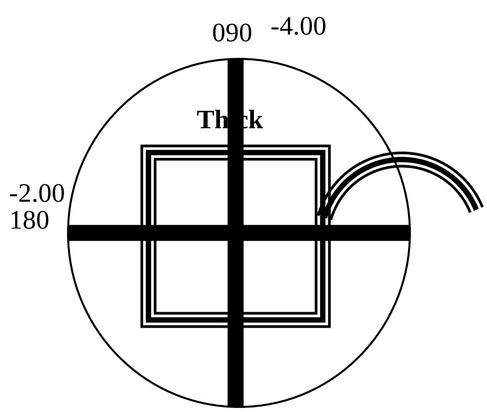
Place the prescription on a lens cross.

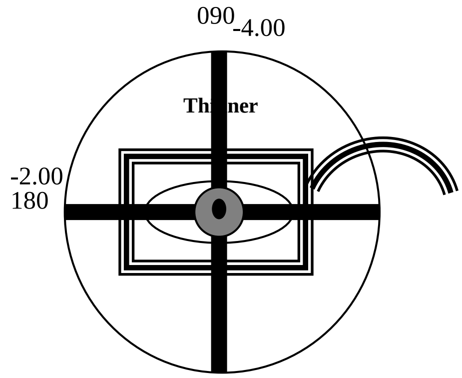


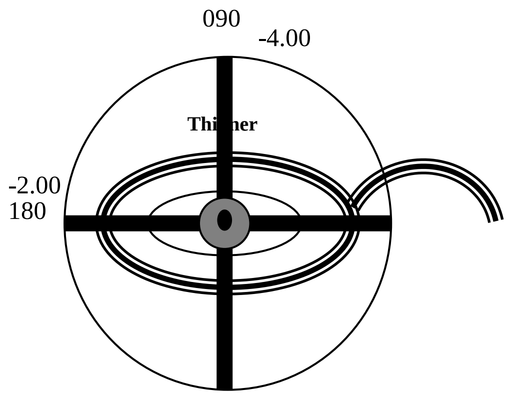
Draw a circle around the lens and you will see where it is thick and where it would be thinner.



Consider shapes to affect edge thickness







Remember that YOU will be designing eyewear for your patients and YOU need to know what to recommend.

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