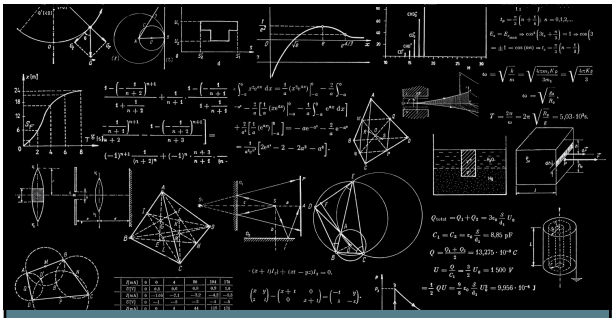

Advanced Ophthalmic Optics

Phernell Walker, MBA, LDO, ABOM

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Phernell Walker, MBA, ABOM, LDO

- Master in Ophthalmic Optics
- Master in Business Administration
- Bachelor of Science in Business
- Associate of Science in Opticianry
- Past Adjunct Professor – Pacific University College of Optometry
- ABO & NCLE Certified
- Author of text-book, *Pure Optics*
- Joe Bruneni Award, Association of Schools Colleges of Optometry
- Beverly Meyers Achievement Award in Ophthalmic Optics

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Contact Information

Phernell Walker, MBA, ABOM, LDO

Web: www.pure-optics.com

Email: phernell@pure-optics.com

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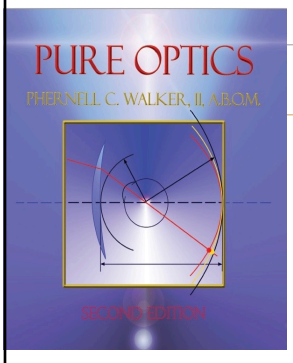

Content Resource

Pure Optics (2021)

Phernell Walker, MBA, ABOM, LDO

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Objectives

- Geometric Optics
- Position of Wear Optics and Ophthalmic Lenses
- Optical Design Considerations
- Q & A

6

Lens Power

- Base Curve (front vertex power)
- Ocular Surface (anterior vertex power)
- Lens Thickness (measured in meters)
- Refractive Indice

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Using Formulae' to Create Lens Appeal

Practical:

$$D_1 + D_2 + (t)\,(D_1)^2 / n = D_e$$

Exact:

$$[\, D_2 / 1 - (t/n)\,(D_2)\,] + D_1 = D_e$$

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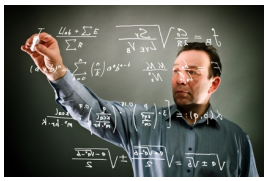
Variable Key

- D_1 = base curve
- D_2 = ocular curve
- t = thickness (M)
- n = refractive index
- D_e = total dioptric power
- 1 = constant



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Lights Camera Action

A lens has a base curve of +9.00D, Ocular curve of -2.00D, 7mm thick and is made of plastic 1.60n.

What is the lens power the patient will experience?

$$D_1 + D_2 + (t)\,(D_1)^2 / n = D_e$$

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"The Envelope Please"

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And there you have it!

Formula:

$D_1 + D_2 + (t)\,(D_1)^2 / n = D_e$

$+9.00 + -2.00 + (7mm)\,(9.00)^2 / 1.60 = D_e$

$+7.00 + (\ .007m)\,(81\ ) / 1.60 = D_e$

$+7.00 + .567 / 1.60 = D_e$

$+7.00 + .35 = D_e$

$+7.35 = D_e$

*Power experienced by the patient ignoring vertex distance

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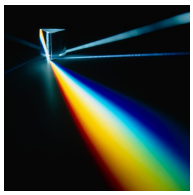
Resolving and Resulting Prism

- Rectangular (Resolving Prism)
- Polar Coordinate (Resultant)



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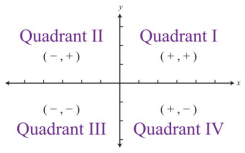
Prism Rectangular Form

- B.I.
- B.O.
- B.U.
- B.D.
- Combination



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Rectangular Prism Notation

Polar coordinate prism notation indicates the base direction in degrees. There may be times when you will need to convert between rectangular and polar coordinate prism form.

This can be most useful when neutralizing lenses (determining the unknown power of a lens) with a lensometer.

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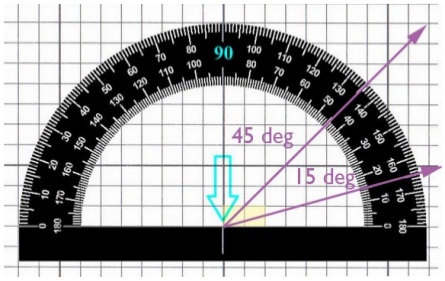
Polar to Rectangular Prism Conversion



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Polar Notation to Rectangular

$V = (D_e)$ (sine a)

$H = (D_e)$ (cosine a)

V = Vertical Coordinate
H = Horizontal Coordinate
D_e = Power of Prism

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Polar to Rectangular Prism Conversion

Example:

Convert the following prescription from polar notation to rectangular notation:

O.D. ~~+~~3.25 DS, 4 Prism, B.I. @ 045

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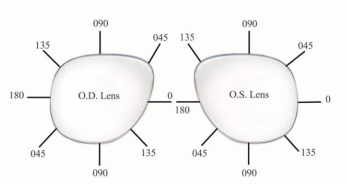
Solution:

OD: +3.25 DS, 4^{Δ} BI @ 045

V = (4.00) (.707)
H = (4.00) (.707)
V = 2.82
H = 2.82

OD: +3.25, 2.82^{Δ} B.U., 2.82^{Δ} B.I.Notice the rectangular coordinates for the right eye directly corresponds with the polar coordinate of 045 degrees (fig. 11-5).



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Resultant Prism

When generating prescriptions and creating prism in an optical lab, it is important to know the exact location of the prism's base.

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Rectangular to Polar Notation

$\sqrt{P} = H^2 + V^2$

$\tan^{-1} a = V / H$

where:

$\sqrt{P}$ = prism (square root of the prism)
V^2 = vertical coordinate
H^2 = horizontal coordinate

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Convert Resultant into Polar Prism

Example:

OD +3.00 DS, 4 Prism B.I. & 2 Prism B.U. from rectangular to polar prism

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$\sqrt{P} = H^2 + V^2$

$\sqrt{P} = 4^2 + 2^2$

$\sqrt{P} = 16 + 4$

$\sqrt{P} = 20$

$\sqrt{P} = 4.47\ D^{\Delta}$

$\tan^{-1}\ a = V / H$

$\tan^{-1} a = 2 / 4$

$\tan^{-1} a = .50$

Converted Rx: +3.00 DS, 4.47 D^{Δ} @ 27 degrees

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Position of Wear

POW - describes the relationship between the eyewear adjustment and the patient

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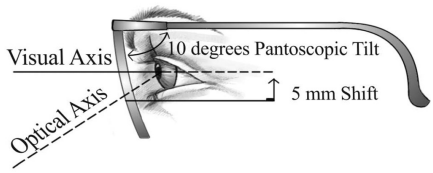
Martin's Tilt Formula



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Power Factors

- Nominal Prescription
- OD: -8.50 DS
- OS: -8.50 DS
- Pantoscopic Tilt = 15 deg
- n = 1.498 (Cr-39)
- Vertex = 13mm

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Optics of Tilt

$S_{De} = S\,[1 + (\sin@)^2 / 2_n]$		
$C_{De} = S_{De}\,(\tan@)^2$		
S_{De}	=	effective sphere power
S	=	sphere power
n	=	refractive index
C_{de}	=	effective cylinder

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$S_{De} = S\,[1 + (\sin@)^2 / 2_n]$

- $S_{De} = S\,[1 + (\sin@)^2 / 2_n$
- $S_{De} = -8.50\,[1 + (\sin 15)^2 / 2\,(1.498)]$
- $S_{De} = -8.50\,[1 + .06698 / 2.996]$
- $S_{De} = (-8.50)\,(1 + .02235)$
- $S_{De} = (-8.50)\,(1.02235)$
- **$S_{De} = -8.68$**

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$C_{De} = S_{De}\,(\tan@)^2$

$C_{De} = -8.68\,(\tan 15)^2$

$C_{De} = (-8.68)\,(0.267949)^2$

$C_{De} = (-8.68)\,(0.071796)$

$C_{De} = -0.62$

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Lens Tilt Resultant Rx

Nominal Prescription	Effective Power
OD: -8.50 DS	-8.68 -0.62 x 180
OS: -8.50 DS	-8.68 -0.62 x 180

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Power Compensated Lenses

Nominal Prescription	Effective Power	Compensated Power
OD: -8.50 DS	OD: -8.68 -0.62 x 180	OD: -8.32 +0.62 x 180
OS: -8.50 DS	OS: -8.68 -0.62 x 180	OS: -8.32 +0.62 x 180

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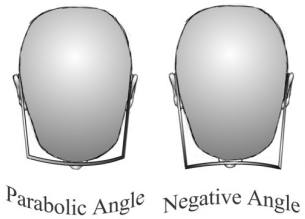
Nominal Prescription
OD: -6.00 -1.00 x 180
OS: -6.00 -1.00 x 180

- Parabolic Angle = 20 deg.
- n = 1.70
- Vertex = 13 mm



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Convert to 090th Meridian

OD: -6.00 -1.00 x 180
OS: -6.00 -1.00 x 180

Transpose

OD: -7.00 +1.00 x 090
OS: -7.00 +1.00 x 090

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Quantify the Issue

$S_{De} = S\,[1 + (\sin@)^2 / 2_n]$

$C_{De} = S_{De}\,(\tan@)^2$

S_{De}	=	effective sphere power
S	=	sphere power
n	=	refractive index
C_{De}	=	effective cylinder

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Calculate the Sphere

$S_{De} = S\,[1 + (\sin@)^2 / 2_n$

$S_{De} = -7.00\,[1 + (\sin 20)^2 / 2\,(1.70)]$

$S_{De} = -7.00\,[1 + 0.1169 / 3.40]$

$S_{De} = (-7.00)\,(1 + 0.034)$

$S_{De} = (-7.00)\,(1.034)$

$S_{De} = -7.24$

35

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Calculate the Cylinder

$C_{De} = 7.24\,(\tan 20)^2$

$C_{De} = 7.24\,(\tan 20)^2$

$C_{De} = (7.24)\,(\tan 20)^2$

$C_{De} = (7.24)\,(\tan 20)^2$

$C_{De} = (7.24)\,(0.36397)^2$

$C_{De} = (7.24)\,(0.13247)$

$C_{De} = +0.96$

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Lens Tilt 180th Effective Power

Nominal Prescription

OD: -6.00 -1.00 x 180
OS: -6.00 -1.00 x 180

Original (Transposed) to 090th Meridian:

OD: -7.00 +1.00 x 090
OS: -7.00 +1.00 x 090

Resultant Effective Power

Answer:
-7.24 +1.96 x 090, OU

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Power Compensated Lenses

Nominal Prescription	Effective Power	Compensated Power
OD: -6.00 -1.00 x 180	OD: -5.28 -1.96 x 180	OD: -6.80 -0.04 x 180
OS: -6.00 -1.00 x 180	OS: -5.28 -1.96 x 180	OS: -6.80 -0.04 x 180
OD: -7.00 +1.00 x 090	OD: -7.24 +1.96 x 090	OD: -6.76 +0.04 x 090
OS: -7.00 +1.00 x 090	OS: -7.24 +1.96 x 090	OS: -6.76 +0.04 x 090

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Blurry Vision with New Soft Toric Contacts

CC:	Blurry Vision
Location:	Distance Vision
Onset:	New Contacts
Severity:	6
Duration:	Constant
Mod. Fac:	None

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Soft Toric Contact Lenses

Presenting Rx	SCOR
- Cyl: -8.50 -2.00 x 180	- CYL: -0.50 -0.75 x 140
+Cyl: -10.50+2.00 x 090	+ Cyl: -1.25 +0.75 x 050

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Combining Cylinders

$$C^2 = C_1^2 + C_2^2 + 2C_1 C_2 \cos 2y$$

$$S = (S_1 + S_2 + C_1 + C_2 - C) / 2$$

$$^{-1}\tan /2 = C_2 \sin 2y / C1 + C2 \cos 2y$$

- Lower Axis Rx $= S_1\, C_1 \times a_1$
- Higher Axis Rx $= S_2\, C_2 \times a_2$
- $y = a_2 - a_1$

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Calculate New Cylinder

$C^2 = C_1^2 + C_2^2 + 2C_1 C_2 \cos 2y$

$C^2 = 0.75^2 + 2^2 + 2\,(0.75)\,(2) \cos 2(40)$

$C^2 = 0.5625 + 4 + 1.50\,(2) \cos 80$

$C^2 = 0.5625 + 4 + 3\,(0.17)$

$C^2 = \sqrt{5.07}$

C = +2.25 •plus cylinder format

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Calculate New Sphere

$S = (S_1 + S_2) + (C_1 + C_2 - C) / 2$

$S = (-10.50 + -1.25) + (0.75 + 2.00 - 2.25) / 2$

$S = -11.75 + -0.50 / 2$

$S = -11.75 + -0.25$

$S = -11.50$ *plus cylinder format

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Calculate New Axis

$^{-1}\tan /2 = C_2 \sin 2y / C_1 + C_2 \cos 2y$

$^{-1}\tan /2 = 2.25 \sin 80 / 0.75 + 2 \cos 80$

$^{-1}\tan /2 = 2.21 / 1.10$

$^{-1}\tan /2 = 2.01$

$^{-1}\tan /2 = 64$

Axis = 31.77 degrees of change

Add 32 degrees to a_1 (32 + 50 = 081)

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Corrected Soft Toric Contacts

Presenting Rx	Corrected Rx
+ CYL: -10.50 +2.00 x 090	+ CYL: -11.50 +2.25 X 081
- CYL: -8.50 -2.00 x 180	- CYL: -9.25 -2.25 X 171

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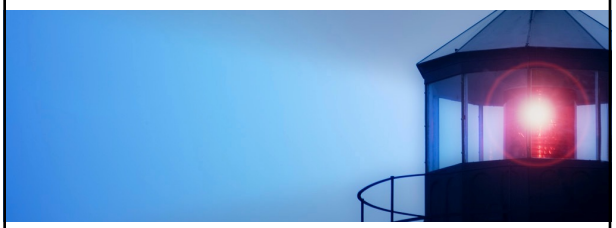

Questions

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