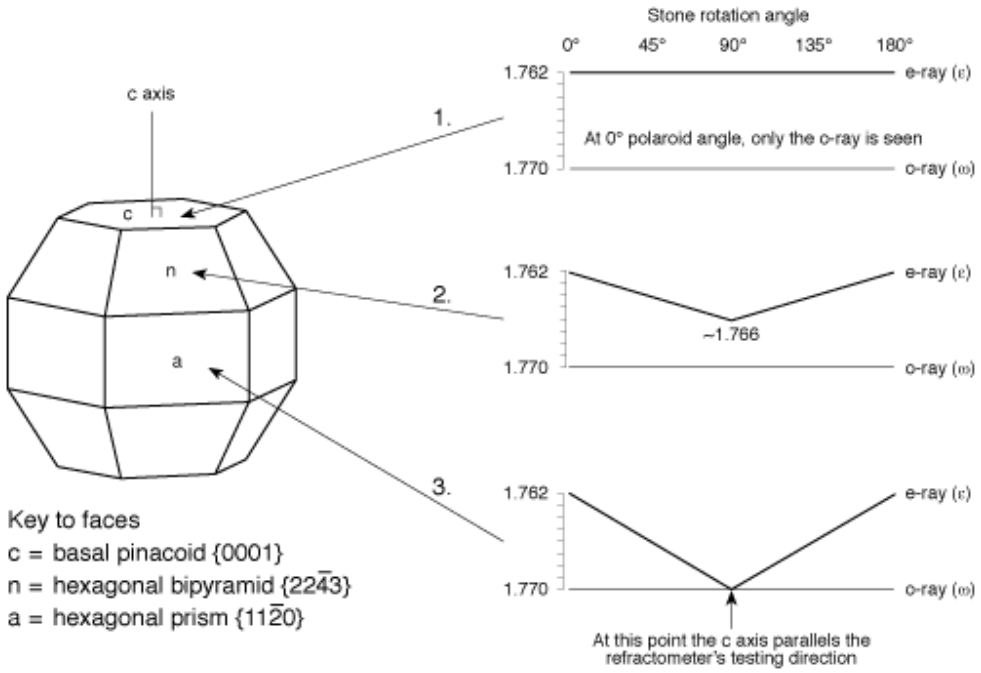
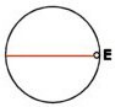
Optic Character & Sign on the Refractometer

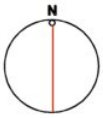


RI readings for different faces on corundum. Corundum is uniaxial negative. (note: e-ray should be drawn as a curve not a "V") Illustration © Richard W. Hughes

Polaroid Angle



0° Polaroid angle is when the transmission direction of the Polaroid plate is parallel to the refractometer scale divisions (East – West).



90° Polaroid angle is when the transmission direction of the Polaroid plate is perpendicular to the refractometer scale divisions (North – South).

Shadow Edge Variations: Uniaxial or Biaxial (*see Sturman charts patterns* I through VII)

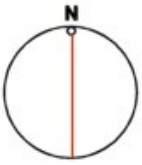
1. Two constant shadow edges = Uniaxial (II)

2. Two variable shadow edges = Biaxial (V, VI, VII)

3. One constant & one variable, which **meet but do not cross** = Uniaxial (III)

4. One constant & one variable which **do not meet,** then check the Polaroid angle of the constant shadow edge when the shadow edges are the closest: (IV)

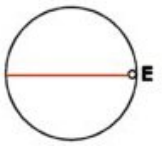
- Biaxial = Polaroid angle of constant shadow edge = 90°
  Variable edge disappears
- Uniaxial = Polaroid angle of constant shadow edge ≠ 90°
  Constant edge disappears



Optic Sign

Uniaxial Stones

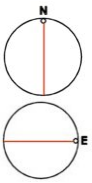
1. High RI shadow edge varies = **(+)** $\varepsilon > \omega$ (III)
2. Low RI shadow edge varies = **(-)** $\varepsilon < \omega$ (III)
3. Both shadow edges constant: at 0° Polaroid angle, only the o-ray is seen (II)
   - If **low** shadow edge is seen = **(+)**
   - If **high** shadow edge is seen = **(-)**



"Because the o-ray always vibrates 90° to the c-axis, orienting the transmission direction of the eyepiece Polaroid at 90° to the c-axis (parallel to the scale division lines on the refractometer scale) will allow only the o-ray to be seen (Hughes, 1997)*."*

Biaxial Stones (*see Sturman charts for detailed examples of biaxial patterns)*

1. If β is closer to α, the gem is **(+)**
2. If β is closer to γ, the gem is **(-)**
3. If β is halfway between α and γ, the gem is **(±)**
4. If two possible betas exist then check Polaroid angle when the shadow edges are the closest : (V I)
   - **False beta** will have a Polaroid angle **equal to 90°**
   - **True beta** will have a Polaroid angle **equal to 0°**.



Uniaxial Crystals

ω = omega, the constant RI of a uniaxial crystal (ordinary or o-ray)

ε = epsilon, the variable RI of a uniaxial crystal (extraordinary or e-ray)

Biaxial Crystals

α = alpha, the lowest RI of a biaxial crystal

β = beta, the intermediate RI of a biaxial crystal

γ = gamma, the highest RI of a biaxial crystal

Adapted by Elise Skalwold with kind permission of Dick Hughes:
Hughes, Richard W. (1997) Ruby & Sapphire. RWH Publishing: Boulder, Colorado. Page 65.
Hughes, Richard W: http://www.ruby-sapphire.com/crystal_optics.htm Overview of the crystal systems and their optical properties chart
Further reading supplementing added notations in adapted chart:
Sturman, D. and Back, M.E. (2002) Doubling of images in gemstones. Journal of Gemm., Vol. 28, 4, pp. 210-22.
Sturman, D. (2005) **Use of the polarizing filter on the refractometer**. Journal of Gemm., Vol. 29, 5/6, pp. 341-48.
Sturman, D. (2007) Identification of gemstones using a graph based on birefringence and maximum refractive index. Canadian Gemmologist, 28 (2), pp. 55-59.
Sturman, D. (2007) Determination of the optic axial angle in biaxial gemstones and its use in gemmology. Journal of Gemm., Vol. 30, 7/8, pp. 443-52.
Sturman, D. (2007) Clarification of measurement of the RIs of biaxial gemstones on the refractometer. Journal of Gemm., Vol. 30, 7/8, pp. 434-42.
Sturman, D. and Parker, D. (2008) The "New Approach" to the Teaching and the Use of the Refractometer.
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